Engineering News

VOLUME 71 APRIL 2, 1914 NUMBER 14

The Development of the Port of Boston

By Robert E. Barrett*

SYNOPSIS—The state of Massachusetts has committed itself to a development of the port of Boston by an initial appropriation of $9,000,000 and the formation of an independent board, known as the Directors of the Port of Boston, to whom is entrusted the planning and execution of future work. Already the expenditure of practically all of that sum has been authorized for the construction and equipping of piers and a dry dock of record size. This article outlines the work already done and in prospect.

History of the Harbor

Development of the harbor of Boston has been in progress since the latter part of the seventeenth century. Boston, during this period, was a peninsula and consisted of an area of but 1.25 square miles. This peninsula, located within the inner harbor and sheltered from the sea by Point Shirley on the north and Point Allerton on the south, became the commercial center of New England. During the past two centuries the area of Boston proper has increased from 1.25 to 3.00 square miles. Even the original shore line, as shown on the harbor chart of 1776, has been almost entirely obliterated. During the years 1709-1710, there was constructed in Boston a pier nearly 2000 ft. in length and 30 ft. in width, extending far enough into the bay to admit of the unloading of ships of greatest burden. Boston Pier, later known as Long Wharf, has become the lower end of State St., the principal street in Boston's financial district, and new piers have been extended into the harbor forming the present Atlantic Ave. water front.

The tide in Boston harbor is about ten feet, and owing to the existence of flats of shallow flowage, a question of ownership early arose concerning that strip over which the sea ebbed and flowed. In order to definitely determine ownership of this area, Massachusetts Bay Colony passed ordinances in 1641 and 1647 giving to the upland abutter the ownership of this strip of land, but in no case should the ownership extend to points more than 100 rods from the high-water mark. From the low-water mark or the 100-rod line for a distance of one marine league to sea, ownership remained vested in the Colony, later the Commonwealth of Massachusetts. Jurisdiction over this large amount of land extending along the shores of the state was intrusted to various Boards of Harbor Commissioners and later to a Board of Harbor and Land Commissioners, who not only controlled all state property along the waterfront, but were also given police control of private property in tide-waters, covering obstructions to navigation and the granting of licenses to private individuals for the construction of wharves, sea walls and other structures in tide-water. For all construction done in tide-water the Board was authorized to require the licensee to excavate somewhere within the harbor between high- and low-water marks, a volume equal to the tide-water displacement of the structure built or pay to the Commonwealth such sum not exceeding 37½c. for each cubic yard so displaced, as the Board should determine, the income so derived to be used for the development of the harbor. Criminal jurisdiction over tide-water rests with the City Police; the Harbor

Fig. 1. Commonwealth Pier No. 5, Boston Harbor, before Construction, Dec. 10, 1912

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Master is the Captain of the Harbor Police and regulates anchorage in the harbor and maintains a police patrol. The improvement of the main channels and establishment of pierhead lines is undertaken by the United States through the United States Engineers under authority given Congress to regulate commerce.

Since the ownership of the Commonwealth covered the area below the low-water mark, development of land between high and low water was left to its private owners. At the same time, however, large areas of shallow flowage below low water were filled by the state and revenue obtained by its sale or rental to private owners. Dredging of harbor channels and filling of these submerged lands known as "flats" has continued from year to year until large areas in the vicinity of Boston have been filled. Although the Commonwealth has sold large areas of filled land, it still retains the ownership of a large area on the South Boston Flats (Fig. 3).

It became evident to the people of Massachusetts in 1911 that more attention should be given to the development of its most important port in order to satisfy the future needs of commerce. Consequently, the Governor was authorized to appoint three persons, and the Mayor of the City of Boston one person. The four persons so appointed, with the Chairman of the Harbor and Land Commissioners, *ex-officio,* to constitute a board known as the Directors of the Port of Boston. Hugh Bancroft was appointed chairman of the board. The other members at present are Joseph A. Conry, William F. Fitzgerald, William S. McNary and Francis T. Bowles. The Directors appointed as clerk, James T. MacDonald, and as Chief Engineer, Frank W. Hodgdon, formerly Chief Engineer of the Harbor and Land Commission.

The Directors were given jurisdiction over that portion of the Massachusetts waterfront occupied by the harbor of Boston lying westerly of a line between Point Allerton on the south and the southerly end of Point Shirley on the north, and with an initial appropriation by the state of $9,000,000 were instructed to develop the port by the taking of land, building piers, warehouses, elevators, dry docks, and by doing such dredging and filling as would be consistent with a comprehensive development for the harbor as a whole, serving by its railway connections the needs of the entire state.

Interpreting broadly the legislative act by which the Directors were established, they have caused to be made a careful analysis of the movements of freight in the Commonwealth as well as the export and import traffic through the port of Boston in order that a comprehensive plan of development of the port could be made. Belt-line railroads outside the city, connecting the various railways, have been studied, as well as tunnels beneath the harbor connecting the railway terminal in East Boston with the terminal in South Boston, in order to reduce both the time and charges involved in the switching and transshipment of freight within the city limits.

Studies were made for the comprehensive development of the harbor as a whole and in its most important subdivisions, East Boston, Boston proper and South Boston.

As a whole, the harbor is most fortunate both in its proximity to the ports of Europe and those on the east coast of South America, and upon the opening of the Panama Canal with the west coast of both North and South America. Boston harbor is about 110 nautical miles nearer Liverpool than Montreal and about 194 nautical miles nearer than New York, a factor which must be considered seriously by the management of transatlantic steamship lines, for the ocean travel involved in 14 trips from Liverpool to New York is equivalent to 15 trips from the same port to Boston.

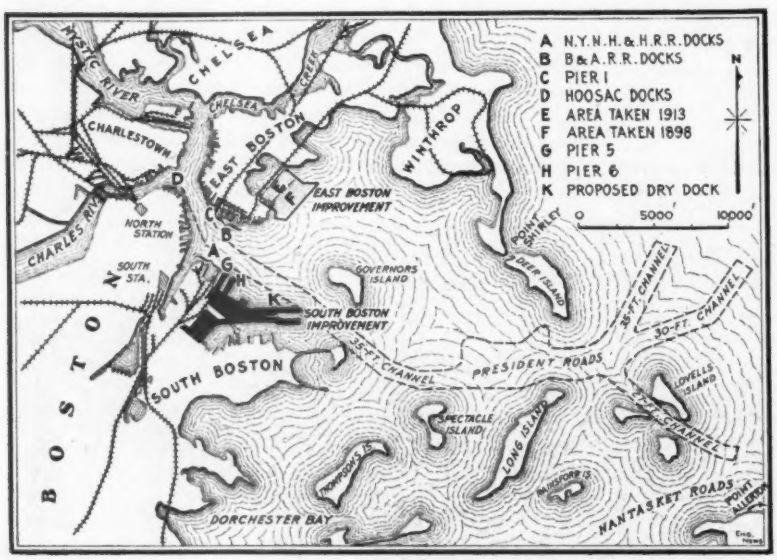


FIG. 2. THE PORT OF BOSTON, SHOWING NEW WORK AT EAST BOSTON NOW UNDER WAY

It has been said that "the internal area of a harbor should bear such a relation to the width of entrance as to produce a sufficient degree of tranquility" and the difficulty involved in properly adjusting these relations in artificial harbors is a matter of record. There are probably few harbors in the world where the inlets from the ocean are better adjusted to the amplitude of the interior basins or whose excellent anchorage grounds are so easy of access and yet so land-locked and sheltered by islands as to furnish such protection for the frailest of fishing craft. The influence of this protection has been great in making Boston the largest fishing port in America and second only to Grimsby, Eng., in this industry. Practically the entire waterfront, which has been developed for the accommodation of navigation, is held by private ownership.

The municipality owns and controls only enough of the commercial waterfront which it needs for municipal uses, and, previous to the present year, the piers at which the oversea trade was conducted were practically all owned by the railroad companies.

The principal work undertaken by the Directors of the

Port is the development of the South Boston Flats, by the reconstruction there of a large pier for the use of transatlantic steamship companies and the completion of another for the use of the Boston Fish Market Corporation, the construction of a dry dock and the construction of a new pier in East Boston. These will be described in turn.

South Boston Flats

In their desire to improve the traffic conditions of the port and economically develop for the state the Port of Boston, the Directors, upon their appointment in 1911, turned to the South Boston Flats and considered its development (see Fig. 2).

The Commonwealth in 1867, undertook to reclaim an area of flats to the south of the intersection of the

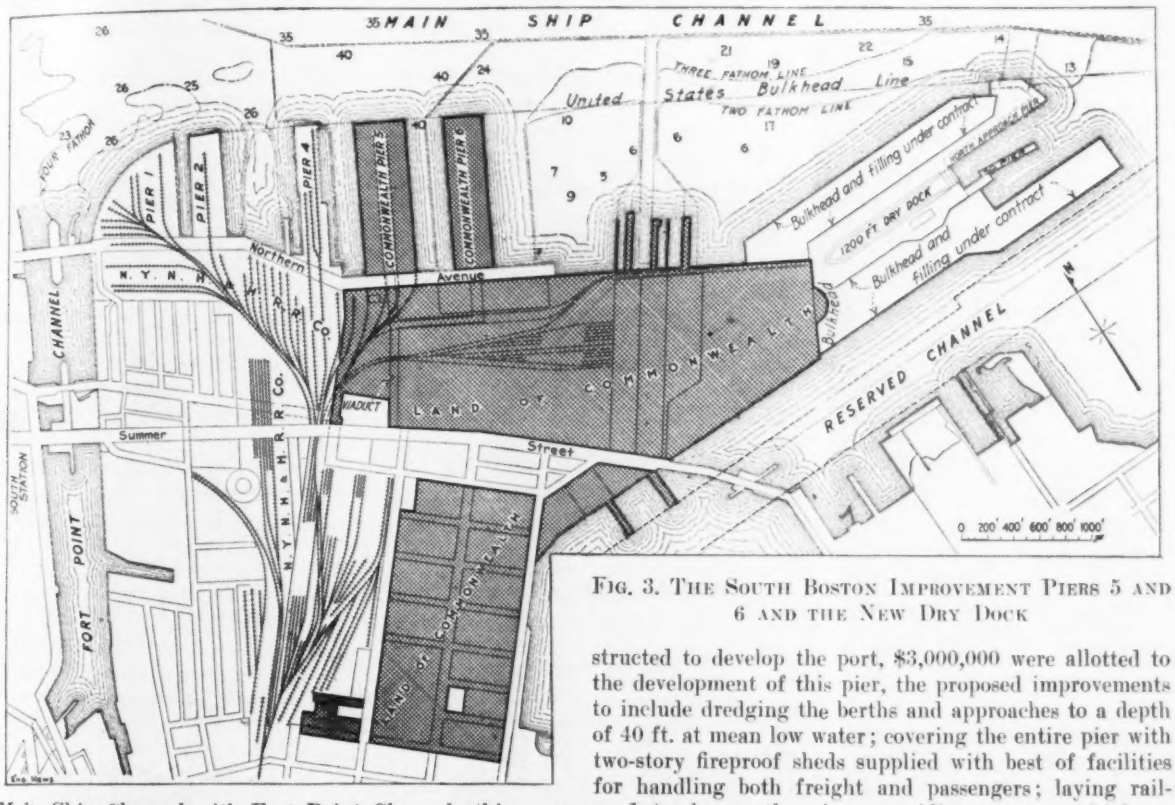


Fig. 3. The South Boston Improvement Piers 5 and 6 and the New Dry Dock

Main Ship Channel with Fort Point Channel; this area was known as the "Twenty-five acre piece." This filling was accomplished under contracts dated 1873 and 1875 and was completed in 1877 and comprised an actual area of 20.64 acres of filling and 3.67 acres of docks costing 87½c. per sq.ft. of filled land and an average of 68c. per sq.ft. including land and docks.

Piers Nos. 1, 2 and 4 were owned by the New York, New Haven & Hartford R.R. Co., and Pier No. 5, finished by the Harbor and Land Commissioners in 1900 after an expenditure of $400,000, had been leased to the same company for a long period of years. These piers were built by filling in with earth between granite walls, founded on the harbor bottom.

As a site for a passenger terminal of large proportions, attention centered upon Commonwealth Pier No. 5, although leased for a long term of years. Its location and length of 1200 ft. afforded the best opportunity to supply in the shortest time and at the least expense a terminal capable of accommodating the largest vessels and the Directors believed that if possession of this pier could be obtained, they might be able to secure for the port the type of ships desired. Therefore, on Nov. 6, 1912, after several months of negotiating, the Directors obtained possession of this pier through an agreement with the New York, New Haven & Hartford R.R., by which the lease was canceled, and steps toward its development were immediately undertaken.

Commonwealth Pier No. 5

This pier was 1200 ft. long and 400 ft. wide within fender lines. The docks had been dredged to a depth of 35 ft. at mean low water.

Of the $9,000,000 with which the Directors were instructed to develop the port, $3,000,000 were allotted to the development of this pier, the proposed improvements to include dredging the berths and approaches to a depth of 40 ft. at mean low water; covering the entire pier with two-story fireproof sheds supplied with best of facilities for handling both freight and passengers; laying railroad tracks on the pier; providing necessary highway connections, including a steel viaduct for passenger traffic from the second story of the pier to Summer St., by which the city proper is reached by a street clear of railroad grade crossings—a distance of 1200 ft.

On Nov. 21, 1912, an agreement was made between the Hamburg-American Line and the Directors of the Port, by which the former agreed to institute its new service to the port in May, 1913. On Dec. 9, 1912, a contract for the reconstruction of the pier was awarded to H. P. Converse & Co., and on May 30, 1913, about five months later, the pier was formally opened to the public and on the following day the Hamburg-American S. S. "Cincinnati" arrived on her first trip (Fig. 6) and her 1200 passengers were discharged to the second floor of the pier, temporarily equipped for the accommodation of passengers. Two sailings each month have been maintained during the construction of the passenger and easterly

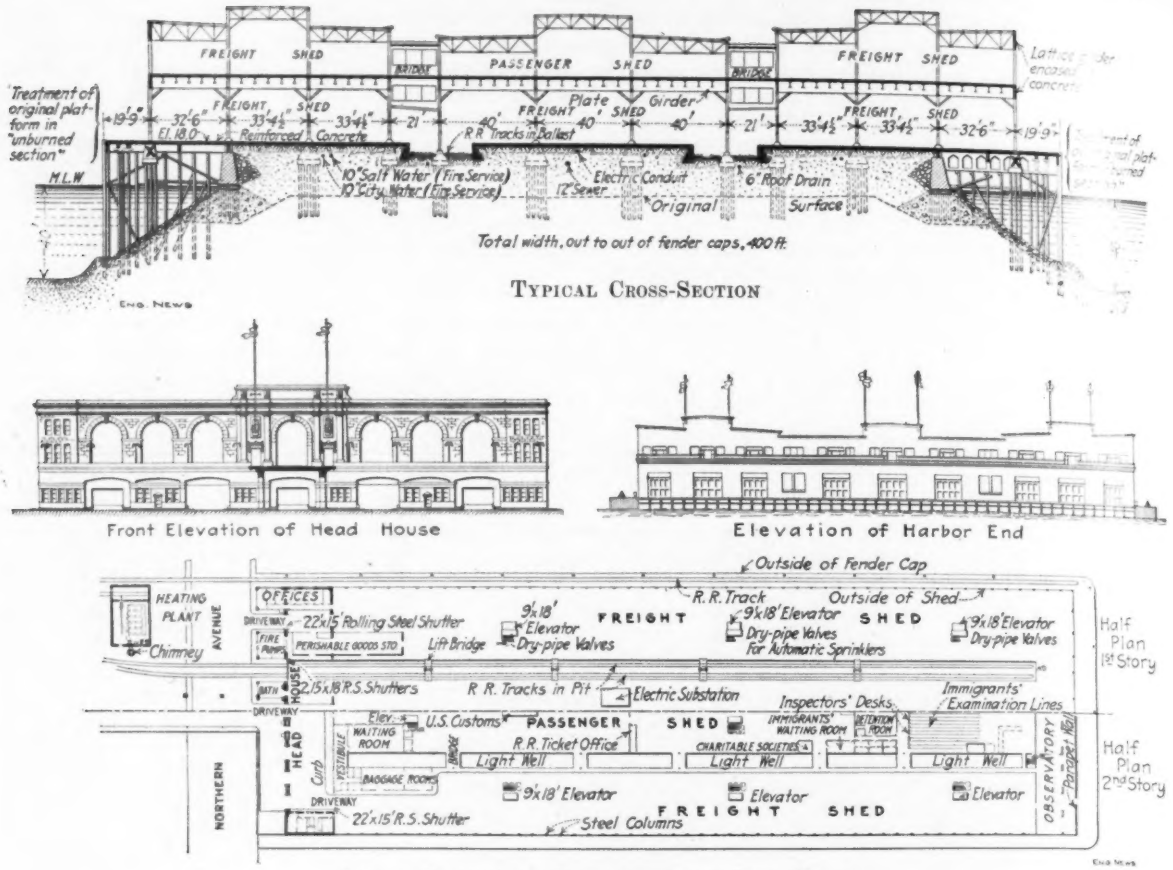


FIG. 4. DETAILS OF COMMONWEALTH PIER NO. 5

sheds with practically no interference to traffic or delay to construction.

The pier as built in 1900 consisted of an earth fill 300 ft. wide between granite retaining-walls founded on piles, with a 50-ft. timber platform on each side, making a total width of 400 ft. and a total length of 1200 ft. The later construction consisted in the erection of a structural-steel and concrete shed with timber roof, over practically the whole of the pier, and the replacement of the timber platforms by a reinforced-concrete deck resting partly on old and partly on new wooden piles. The general section through the pier is shown in Fig. 4.

In the filled part of the pier, the column bases were made of concrete, resting on wooden piles. The entire surface of the pier, with the exception of the track pits, was then covered with a concrete floor. In the platform two types of construction were used; one where the old timber platform had been damaged by fire, and the other where it was still intact. The two types are shown at the right and left, respectively, in the section in Fig. 4, and the details are given at the left and right in Fig. 5.

In the burned portion of the platform the damaged piles were cut off at Grade 10, thus necessitating deep

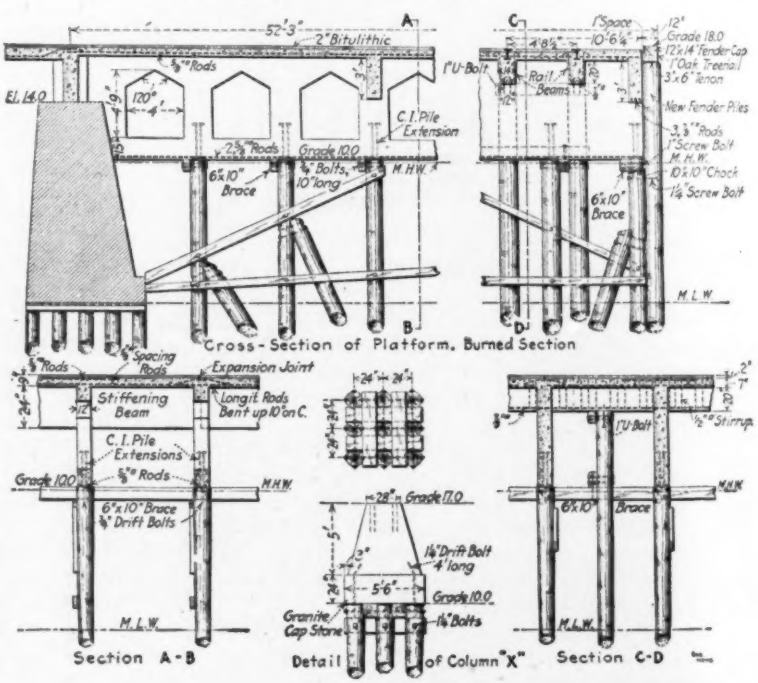


FIG. 5. DETAILS OF CONSTRUCTION

concrete beams in which economy holes were left.

Structural Details—The pier superstructure (Fig. 4) consists of three sheds connected together with light wells 20 ft. wide between them. All floors are to be used for freight except the second floor of the middle shed, which is to be fitted for the accommodation of passengers. For 100 ft. at the shore end a headhouse, architecturally treated with artificial stone, is being erected. This headhouse will contain offices, passenger accommodations and a carriage concourse on the second floor connecting with the viaduct to Summer St. The architectural treatment has been designed by Henry F. Keyes, Architect. The entire framing is of structural steel with concrete floors and siding, according to designs furnished by Joseph R. Worcester, Consulting Engineer. Designs for electric, steam and sanitary equipment were furnished by the Sanitary Engineering Co. The original timber platforms 50 ft. wide, extending along each side and the outer end of the pier were removed and replaced by reinforced-concrete beams and slabs.

Passenger Accommodations—The pier has been designed for the use of one steamship company on each side of the pier, the passenger accommodations covering an area of about 130,000 sq.ft., being located on the second floor of the middle shed.

A continuous line of doors extends along the outer side of the second floor of each freight shed and the various classes of passengers pass from the deck of the steamships to the second floor of the pier by wooden gangways 42 ft. in length; they then pass across the freight shed to their respective portions of the passenger shed crossing permanent covered bridges at the light wells between the sheds. First- and second-class accommodations are located at the land end of the pier and emigrant accommodations are located at the harbor end of the pier, considerable space being occupied by the examination lines, detention room, hearing rooms, doctors' room and room for the use of the charitable societies. Baggage rooms and offices are located at the end of the pier adjacent to the headhouse. Steamship and railway ticket offices and office for U. S. Customs officials are centrally located.

Walls and partitions forming the passenger accommodations are constructed of terra-cotta plastered and ceilings where used are of reinforced concrete, excepting the ticket offices and office for the U. S. Customs officials which are constructed of wood finished with Georgia pine.

Between the examination rooms and the street are waiting and baggage rooms and the carriage concourse connecting with the viaduct to the city. At the sides of the concourse are the offices of the railway and steamship companies and the Directors. The steel viaduct, 1200 ft. long, extends from the pier to Summer St., spans the railway tracks entering the pier on the first floor and the state storage yard for cars, and connects the pier with Boston proper by means of Summer St., and also entirely separates passenger and freight traffic.

Immigrants reach trains on the first floor by means of the steel stairs and elevators connecting the two floors.

The second floor of the three sheds extends 20 ft. farther toward the end of the pier than the roof, thus forming a balcony 20 ft. wide and the entire width of the pier at the harbor end. This balcony is surrounded by a heavy masonry parapet and forms a place where friends and relatives of passengers may watch the incoming and outgoing of steamers with safety and comfort. Three openings through the parapet are provided with removable gates to allow the loading and discharging of passengers at the end of the pier, which forms a berth 400 ft. long.

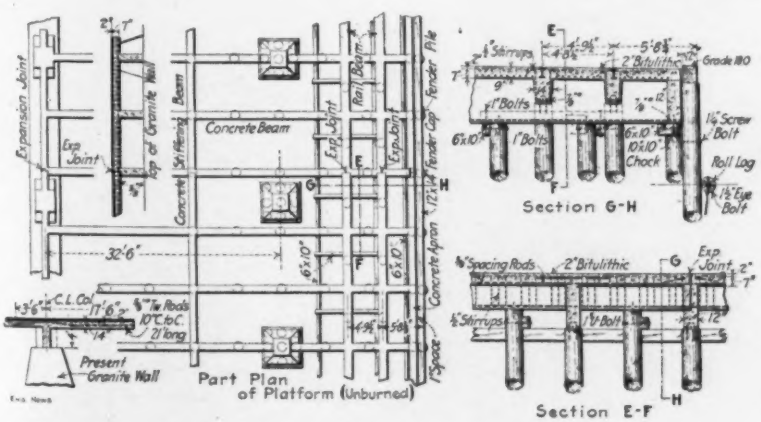
Railway Connections—As shown on Figs. 2 and 4, the pier is provided with railway tracks sunk below the level of the floor so as to allow direct trucking into the cars. There is also a track on each platform outside the sheds. These tracks have direct connection with lines of the New York, New Haven & Hartford R.R. and the freight yard of that company located just southwest of the pier. By this means, freight and passengers can be landed directly at the vessel, a condition that is impossible in New York at present.

Power Services—Across Northern Ave. from the headhouse of the pier there is located a plant for heating the passenger shed on the pier and the offices in the headhouse. This plant contains four 200-hp. return-tubular boilers and with foundations for a fifth boiler of the same capacity, giving a total of 1000 hp. The superstructure of buff brick architecturally treated with artificial stone in harmony with that of the headhouse, is so located with relation to railway connection and Northern Ave. that, should future needs require, another set of five boilers may be added in the rear and an electric generating station constructed between the present plant and the street, the exhaust from the generating plant being then used in the heating of the pier.

The westerly portion of the building is used for the storage of coal, the reinforced-concrete bunker being designed to allow standard-gage coal cars to enter the building and dump their load. The plant is equipped with an industrial coal track extending through the bunker and across the boiler-room floor in front of the fire-doors. Also platform scales weighing to 4000 lb. are provided for the weighing of coal.

Heating of the pier is accomplished by both the direct and indirect systems.

Ventilation for all kitchen, toilet and sanitary rooms, and air circulation in the transformer cells of the electric substation is accomplished by means of electrically driven fans of the



OF FRAMEWORK AT SIDE OF PIER NO. 5.

small multi-vane type with direct-connected motors.

The pier is equipped throughout with a modern installation of sanitary rooms for the convenience of the various classes of passengers and operating forces. All plumbing fixtures are connected to a system of vitrified-pipe sewers laid on concrete base in the solid portion of the pier, connecting at Northern Ave. with the sewerage system of the City of Boston. Storm-water conductors from the roofs of the shed and drains from the valve pits are connected to a drainage system, also laid in the solid portion of the pier, but discharging through the sea wall at various intervals.

Light and power throughout the pier is at present supplied by the Edison Elec. Ill. Co. and transformed at an electric substation located near the center of the pier. The interior lighting of the pier is accomplished by means of about 2000 Mazda lamps, varying in capacity from 100 to 400 watts, equipped with enameled-steel reflectors, making possible the operation of the pier at night as well as by day. Lights are located on the roof of the outer sheds to enable a ship to dock at night.

Freight Accommodations—The entire lower portion of the pier and the second floor of the two outer sheds are to be used for freight, the total area devoted to freight being 500,000 sq.ft. Freight may reach the pier by trucks from Northern Ave. or by any of the six standard railway tracks which cross the avenue at grade. A track pit is provided for two tracks on either side of the middle shed, the tracks being below the first-floor grade sufficiently to bring the car and pier floors at practically the same level. A track on reinforced-concrete rail beams is provided on the platforms at either edge of the pier,

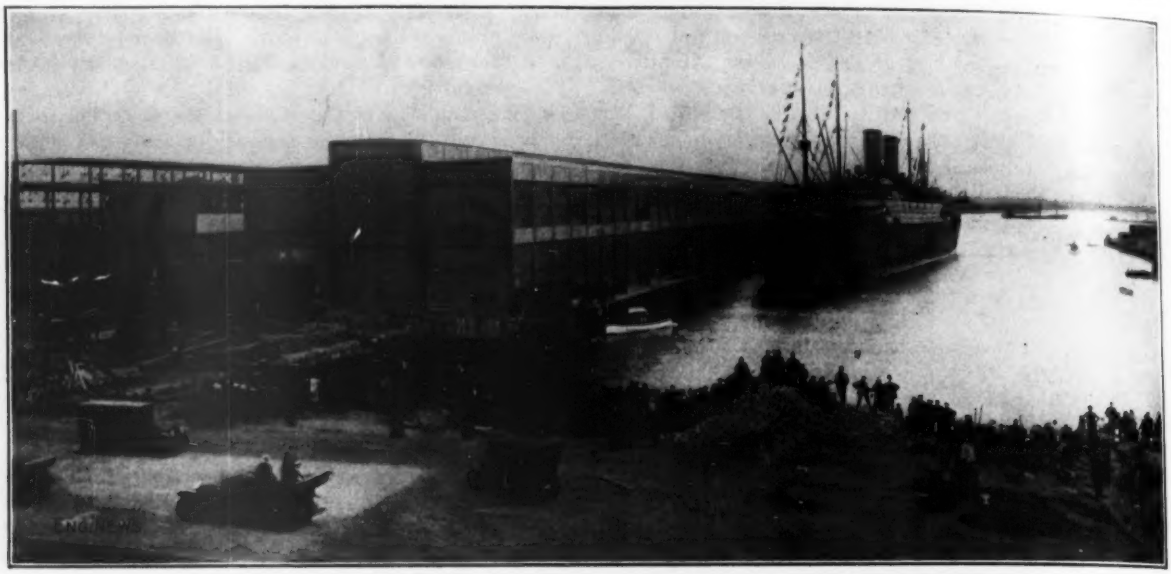


Fig. 6. May 31, 1913, S.S. "Cincinnati" Docking for First Time

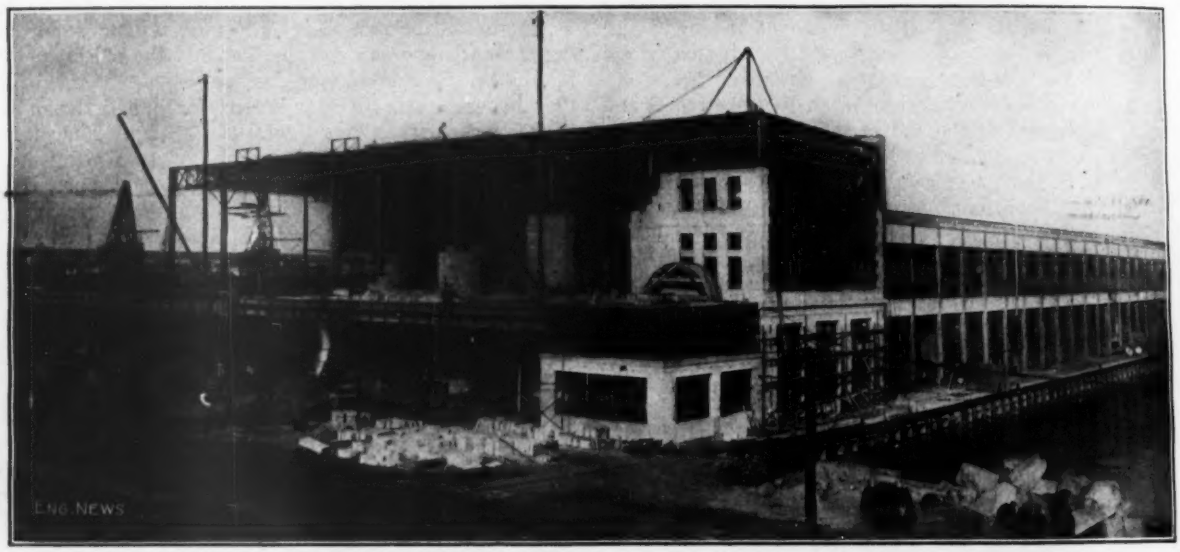
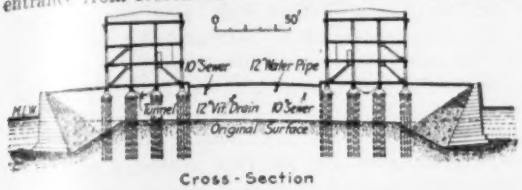


Fig. 7. Dec. 29, 1913. Head House under Construction

Figs. 6 and 7. Commonwealth Pier No. 5 under Construction

these tracks being at the level of the floor of the pier.

In addition to the train entrances, there is a driveway entrance from Northern Ave. to the center of each of the



along the outer sides of the freight sheds in order that the winches may be used at any point.

For moving of freight across the track pits, lifting bridges have been provided. These bridges are supported on a concrete pier between tracks and two leaves are so designed as to hoist into a vertical position between tracks to allow the trains to pass.

FIRE-PROTECTION SYSTEMS—Although practically constructed of fireproof materials, both floors of the passenger and freight sheds, as well as the various rooms in

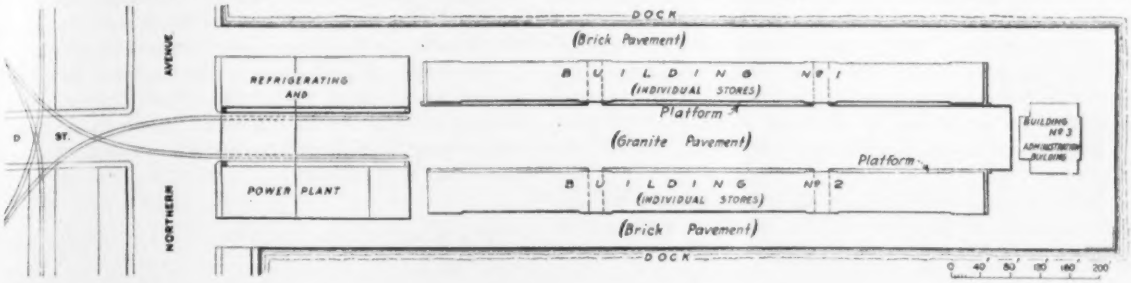


FIG. 8. DETAILS OF COMMONWEALTH PIER NO. 6, KNOWN AS FISH PIER

three sheds for use of teams and auto trucks. Eight elevators with platforms 9 ft. wide and 18 ft. long and headroom of 10 ft., capable of lifting 12 tons at a speed of at least 25 ft. per min. from the lower to the second floor of the pier, are provided for the interchange of freight and hoisting of trucks in the freight sheds.

At the present time, freight on the pier is generally handled by means of hand trucks. Cargo is drawn aboard and lowered into the hold by the ship's winches aided by timber slides and stages. Twenty-six portable electric winches are being provided for use in handling freight. Electric outlets have been placed at frequent intervals

the headhouse, are protected from fire by an automatic sprinkler system with dry valves as a protection from freezing, and with hose connections.

The sprinkler system will be supplied with water under pressure from mains laid in the filled portion of the pier, connected at Northern Ave. with both the high- and low-service mains of the City of Boston.

The distributing mains to the various sprinkler sections are controlled by dry valves located in valve pits at intervals.

In addition to the above system, provision is also made for an independent pipe system for salt water pumped

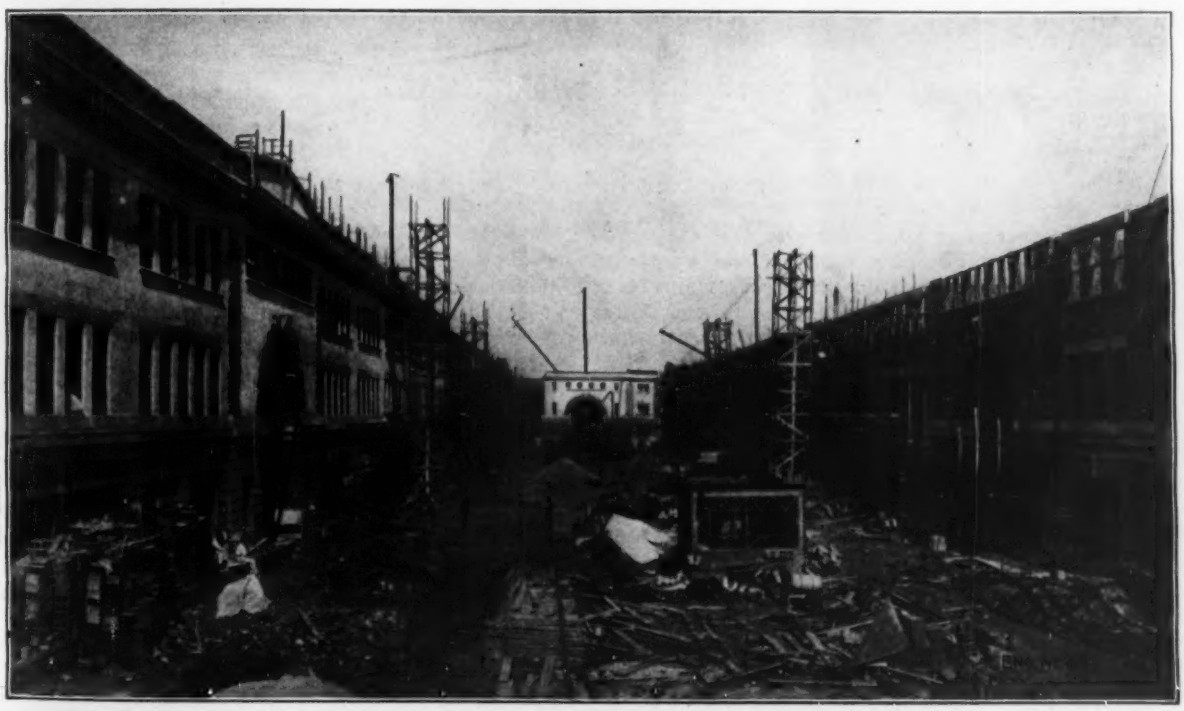


FIG. 9. VIEW OF THE INTERIOR OF FISH PIER, SEPT. 23, 1913, SHOWING STORES UNDER CONSTRUCTION

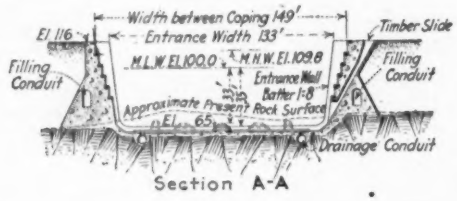
by electrically operated centrifugal pumps to hydrants on both floors and roof.

In the headhouse on Northern Ave., there are located for this system, two motor-driven centrifugal fire pumps of 175 hp. each, capable of discharging 1500 gal. of water per min. against a nozzle pressure of 125 lb. per sq.in.

These pumps obtain water from an 8-ft. diameter reinforced-concrete well sunk as a caisson to a depth of 10 ft. below mean low water; a 24-in. cast-iron pipe with bronze screen connects the well with the water in the west dock.

The pumps are independently equipped but discharge into a common 14-in. diameter main which branches into two 10-in. diameter distributing mains, one beneath the floor on each side of the solid portion of the pier, terminating in 8-in. diameter connections in each of the dry-valve pits.

From the dry-valve pits, distributing piping leads to hose connections and hydrants on all floors and roofs of sheds and headhouse.



erected buildings of terra-cotta, steel and concrete for the accommodation of the various firms forming the Corporation (Fig. 9). The buildings include an Administration Building, Cold Storage and Power Plant and two long buildings containing 44 stores for the various firms in the fish business. The entire property leased by the Fish Corporation comprises 537,100 sq.ft. and provides dock berths for fishing vessels.

The Directors of the Port have provided all water mains, storm water and sanitary sewers, together with brick and granite paving for sidewalks and streets. The pier and its buildings are provided with railway connections to the existing railway system of South Boston.

The buildings, all on pile foundations, have been designed and erected under the supervision of Henry F. Keyes, and Monks & Johnson, Architects & Engineers, and Henry S. Adams has been Consulting Engineer for the Fish Corporation.

Dry Dock

The Directors were required by act of Legislature to investigate and report upon the advisability of constructing a large dry dock at the Port of Boston. After investigating the dry-docking facilities of the Atlantic seaports and those of Boston in particular, they found that dry-docking facilities had not advanced with the construction of large steamships. In their report to the Legislature in 1912, the Directors stated that there were at that time

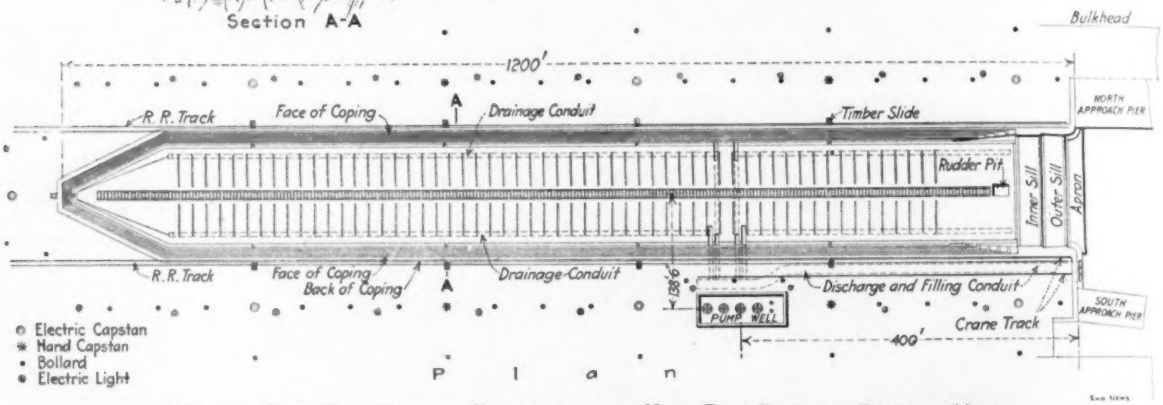


Fig. 10. The Preliminary Design of the New Dry Dock at Boston, Mass.

The starting devices are so arranged that the pumps may be started either by an attendant in the pump room or by means of distant-control switches. The mains being free of water until pressure is needed at the nozzle, the pumps are then instantly started by the distant switch located at each hydrant and hose connection.

In addition to the protection given by the sprinklers and salt-water systems, steel stairs covered by fireproof pent houses on the second floor provide exits for passengers at frequent intervals.

Commonwealth Pier No. 6

Commonwealth Pier No. 6 was constructed by Holbrook, Cabot and Rollins, under a contract awarded by the Harbor and Land Commission, but is being finished under the jurisdiction of the Directors of the Port.

The pier is of solid filling surrounded by granite sea walls inclosing an area 300 ft. in width and 1200 ft. in length (Fig. 8). Upon the solid filled pier built by the Commonwealth, the Boston Fish Market Corporation has

89 steamships entering the Port of New York which could not be cared for in any of the commercial dry docks in New York, 37 of which could not be dry docked there at all, and of these, 19 could not be dry docked in any of the docks in the United States.* Boston's facilities were found inferior to those of New York and other ports on the North Atlantic coast, and the Directors recommended the construction of a dry dock sufficient in size to accommodate the largest of steamships as a necessary and essential element in the contemplated development of the Port of Boston.

During the latter part of 1912, the Directors allotted $3,000,000 of their appropriation to the construction of a dry dock of ample size and suitably equipped to provide for the largest of ocean steamships, and designs and investigations for the structure were begun.

As it was the intention of the Directors to adapt the

*There is now under construction in the St. Lawrence River opposite Quebec a dry dock capable of handling any vessel in existence or proposed, "Engineering News," Dec. 18, 1913, p. 1214.

dry dock and its equipment to the safe and expeditious docking and repairing of the largest ships of the United States Navy, the coöperation of the Navy Department was requested and as a result Civil Engineer Dewitt C. Webb, U. S. N., was assigned to assist the Directors in this work.

Preliminary field investigations indicated the probability of a suitable site for a large dry dock on the southeasterly unfilled portion of the South Boston Flats, where soundings reached ledge rock over a considerable area.

During the spring and summer of 1913, diamond-drill borings were made at the proposed site and rock of a firm slaty nature was found at a depth of from 10 to 40 ft. below mean low water. As a result of numerous studies, the Directors decided to construct upon this site a single-entrance dry dock having an overall length of about 1200 ft., a bottom width of about 120 ft., and a depth of 35 ft. over entrance sill at mean low water, or 44.8 ft. at mean high water (Fig. 10).

The location of the proposed dry dock is entirely outside the present filled area of the flats and is covered with about 7 ft. of water at low tide. Some form of coffer-dam to enable the unwatering of the site during construction was a necessity, and in order to provide for this and also working areas around the dry dock, timber bulkheads were located, connecting with the present filled area and inclosing two areas comprising together about 35 acres. A coffer-dam will be built under a later contract at the outer end, connecting the two filled areas, which will enable the unwatering of the site.

A contract was awarded on Aug. 28, 1913, for the construction of the timber bulkheads, amounting to about 11,000 lin.ft., and on Oct. 27, 1913, a second contract was awarded, covering the dredging of about 950,000 cu. yd. of material in the relocation and deepening of the Reserved Channel near the site of the proposed dry dock, and the placing of this material within the bulkheads to form the filled areas around the dock.

Contract drawings and specifications are being prepared, covering the construction of the dry dock, its pumping chamber, approach piers, and dredging at entrance. Fig. 10 shows the preliminary design of the dock.

An indication of the increased attractiveness which the dry dock will give to Boston as a port is given by the agreement between the Port Directors and the three largest passenger steamship companies: the International Mercantile Marine Co., Hamburg-American Line and Cunard Line. These companies, in consideration of having a preference in assignments of the dock for repairing purposes, have agreed to guarantee a minimum of $50,000 business per year for twenty years.

East Boston Work

In East Boston, as in South Boston, the Commonwealth owns by original right large areas of land known as "flats," but lying between these areas and the land there were other areas owned by private parties.

In 1898, the Commonwealth took by right of eminent domain an area lying between the flats and the land amounting to about 4,400,000 sq.ft., and in 1913, the Directors of the Port took an additional area adjacent to the first consisting of about 2,560,000 sq.ft., in order to insure a comprehensive plan of development of the port as a whole (Fig. 2).

In 1913, the Directors of the Port acquired the property owned by the Boston & Maine R.R., located in East Boston and known as "Eastern Pier," in order that a modern pier, to be known as Commonwealth Pier No. 1, equipped for the handling of passenger and freight business, could be constructed in its place.

On Dec. 4, 1913, a contract was awarded covering the removal of the existing wooden shed and pile foundation, and on Jan. 15, 1914, a contract was awarded to cover the dredging and excavation of about 520,000 cu.yd. of material. This dredging to include the dredging of berths and approaches from the main ship channel to the depth of 40 ft. at mean low water.

Plans and specifications are being prepared for the erection of a pier of fireproof construction, about 1000 ft. in length and 175 ft. in width, the superstructure to be two stories and of steel, with reinforced-concrete floors.

The first floor will be devoted to the handling of freight, access being obtained by means of two driveways at the level of the floor and by two depressed railway tracks in a track pit along the center of the pier; these tracks to connect with the existing railway system in East Boston.

The second floor will be primarily designed for the accommodation of passengers, the examination of immigrants and inspection of baggage, and will be lighted from an electric transformer station on the first floor, and heated by means of an independent heating plant to be constructed on the premises.

At the inner end of the pier a headhouse of masonry and steel will be erected on solid fill and will include the offices of the railway, steamship and other officials, waiting rooms, elevators and other passenger accommodations.

Personnel

Frank W. Hodgdon is Chief Engineer, Directors of the Port of Boston; John N. Ferguson, Ass't. Engineer, is in charge of the construction of Pier 6 and the reconstruction of Pier 5; John L. Howard, Ass't. Engineer, is in charge of the viaduct, heating plant and bulkheads for the dry dock. The Directors have also organized a force for the operation of the various piers under the direction of William J. Doherty, Supt. of Terminals.

The Work Done by the Purification Plant of the Indianapolis Water Co. during 1913, as indicated by chemical changes in the water during treatment, was summarized by C. K. Calvert, chemist of the company, in a paper presented before the Indiana Sanitary and Water Supply Association in the latter part of February, 1914. The plant consists of sedimentation basins, in which alum is used during a part of the year, and slow sand filters. The tons of various materials removed from the water in 1913 were given by Mr. Calvert, and commented on by him as follows:

Insoluble	660		
Iron	45		
Aluminum	28		
Lime	25		
Magnesium	34		
Sulphates	189	Gain	
Total solids	775		
Ammonia	4.4		
Nitrous acid radical	1.56		
Nitric acid radical	13.7		
Oxygen required by water	55.8		1,249,171 cu.ft.
Oxygen dissolved in water	45.9		1,028,531 cu.ft.

The loss of suspended solids which must occur also accounts for the loss of lime, magnesium, iron, aluminum, total solids, and in some measure for that of the nitrogens. The use of aluminum sulphate as a coagulant accounts for the gain in the sulphate radical which displaces carbon dioxide in the carbonates making up the alkalinity of the water.

The loss in material requiring free oxygen is due to some extent to the treatment received during purification since in the water when taken from the river is partially exhausted some of the suspended solids are organic. The free oxygen by the organic matter present.

The Rogers Pass Tunnel

SYNOPSIS—The Canadian Pacific Ry. is building a five-mile tunnel at the celebrated Rogers Pass summit in the Selkirk Mountains, which will lower the grade at the summit 540 ft., eliminate a long grade of 2.2% and save five miles in distance. The tunnel is being driven by a novel method of attack.

The Canadian Pacific Ry. has undertaken a very important task to improve its main line where it crosses the summit of the Selkirk range in the famous Rogers Pass.* An entirely new line is being constructed for a distance of 18 miles and its most notable feature is a five-mile tunnel, under the summit of the pass, which will be, when completed, the longest railway tunnel in North America. That distinction, however, will pass shortly afterward, probably, to the Moffat tunnel under the continental divide, 50 miles west of Denver, which is to be built jointly by the Denver & Salt Lake Ry. and the City of Denver, and will be nearly six miles long if built according to present plans.

The accompanying map and profile show the old and the new lines of the Canadian Pacific at Rogers Pass.

The old line has long grades of 2.2% and reaches a summit elevation of 4330.67 ft. in the pass, while the summit on the new line is 540 ft. lower. The new line will effect a saving of five miles in distance, and has the special advantage of eliminating a stretch of line subject to frequent troubles from snow and requiring long stretches of snowsheds. The present line has nearly five miles of snowsheds in 13 miles, while the new line will have only about 4800 ft. The maximum grades on the new line are 2.2%, but their total length is less than one-third of those on the old line. The total curvature is also reduced considerably and two loops are eliminated. It is proposed to use electric traction. Thus while the maximum train load will remain the same, the operating conditions will be very much more favorable in consequence of the lower elevation, the shortening of the heavy grades, and the reduction of the expense and delay due to snow. A comparison of the two lines is made in the accompanying table.

OLD AND NEW LINES AT ROGERS PASS, CANADIAN PACIFIC RY.

	Old Line Open Summit	New Line Summit Tunnel
Length, between same points	23 miles	18 miles
Max. grades (compensated)	2.2%	2.2%
Length of max. grades	22.15 miles	6.61 miles
Grade through tunnel (tangent)	.....	0.38%
Summit elevation	4330 ft.	3791 ft.
Sharpest curves	10°	10°
Max. train load	870 tons	870 tons
Track	Single	Double

The tunnel will be 26,400 ft. long (exactly five miles), and all on tangent. It will have no intermediate shafts. For about 1100 ft. at each end the material encountered will be clay and boulders. The balance is expected to be in solid rock, mica schist and quartzite, so far as can be judged from the investigations made. The maximum depth of rock above the tunnel will be 5690 ft. In cross-section, the tunnel will be 24 ft. high and 29 ft. wide, with concrete lining through the softer materials.

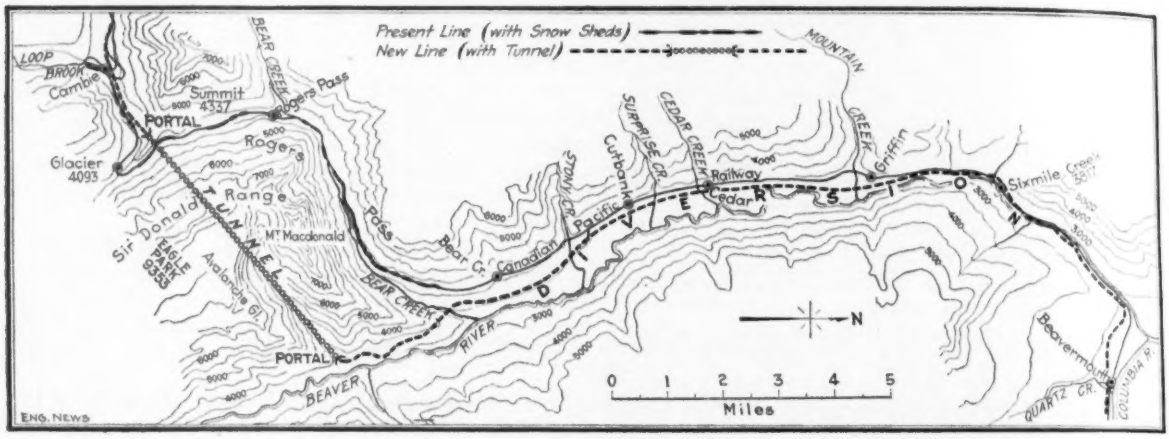


FIG. 1. PLAN OF THE REVISION OF THE CANADIAN PACIFIC RY. AT THE ROGERS PASS (BRITISH COLUMBIA), WITH A DOUBLE-TRACK TUNNEL FIVE MILES LONG

The method of construction is unusual. A pioneer heading or tunnel will be driven 45 ft. from the center line of the main tunnel and with its grade 10 ft. above the subgrade of the latter. From this pioneer tunnel crosscuts will be made to the line of the main tunnel at such distances as may prove desirable, probably 750 to 1000 ft. apart. Drifts from these crosscuts will be driven along the center line of the main tunnel, from which drilling and shooting can be carried on while mucking will be done with air-operated shovels in the enlarged section of the main tunnel. The muck will be handled by 16-yd. side-dump cars and compressed-air locomotives. The drills and ventilating fans will also be operated by compressed air.

By the middle of February, 1914, the pioneer tunnel at the east end had been advanced 900 ft., and the right-hand wall-plate heading at the east portal had been started and carried 30 ft. The headings will be continued, timbering carried on and bench excavated by the air-shovel until rock is encountered. Another steam-

*Another important and costly piece of reconstruction work on the Canadian Pacific Ry., in the Kicking Horse Pass, which replaced 4.5% grades by 2.2% grades and involved the construction of long spiral tunnels, was described in "Engineering News," Jan. 23 and Mar. 19, 1908, and Nov. 10, 1910. A profile of the entire Transcontinental line of the Canadian Pacific Ry. was published in our issue of June 10, 1897.

shovel cut at the west end will enable the pioneer tunnel to be started at that end also.

The work is under the direction of J. G. Sullivan, Chief Engineer of the Canadian Pacific Ry. (Western Lines). F. F. Busteed is engineer in charge, covering grade revision and double tracking as well as the tunnel. For plans and information we are indebted to the engineers. The contractors are Foley, Welch & Stewart, of Winnipeg, and A. C. Dennis is engineer in charge for the contractors. Westinghouse Church Kerr & Co. have been retained as consulting engineers for the electric traction plans.

Government Dredging vs. Contract Dredging

Lieut.-Col. Harry Taylor, Corps of Engineers, U. S. A., Assistant to the Chief of Engineers, Washington, D. C., has compiled the following data in regard to the relative costs of dredging with government-owned plant and by contract, which are published in the *Professional Memoirs* of the Corps of Engineers for March-April, 1914. The data cover the fiscal year June, 1912, to June, 1913, and are essentially as follows:

(*a*) Government dredges excavated during the year a total of 52,564,497 cu.yd. at a cost of $3,786,407.45, or an average rate of $0.072 per cu.yd. This amount of material was divided between the different classes of government dredges as follows: Hydraulic pipe-line dredges, 21,351,780 cu.yd. at a cost of $1,363,534.68 or at a rate of $0.06386 per cu.yd.; by seagoing dredges 27,502,996 cu.yd. at a cost of $1,687,707.78, or at a rate of $0.06136 per cu.yd.; by dipper and bucket dredges, 3,709,721 cu.yd., at a cost of $735,164.99, or at a rate of $0.1981 per cu.yd.

(*b*) Dredging contracts completed during the year or in force at the end of the year, included a total excavation of 181,873,125 cu.yd. at a cost of $26,213,962.70, or at an average rate of $0.1441 per cu.yd. This excavation was divided among different classes of dredges as follows: Hydraulic pipe-line dredges, 101,518,980 cu.yd. at a cost of $10,311,930.39, or at a rate of $0.10157 per cu.yd.; by dipper and bucket dredges, 80,354,145 cu.yd. at a cost of $15,902,032.31, or at a rate of $0.1979 per cu.yd.

In the cost of dredging by government plant there is included all expenses for operation, ordinary and extraordinary repairs, surveys, and such office expenses as are chargeable to dredging operations, while the cost of the contract dredging is the contract cost only, and does not include the cost of government inspection, surveys, office expenses, etc., that are charged against the government plant.

The government dredging plant comprises 22 seagoing dredges, 54 hydraulic dredges, 40 dipper dredges, 22 bucket dredges and the necessary equipment of tugs, scows, pontoons, barges, etc., representing a total investment of $12,583,563. Lieut.-Col. Taylor concludes that the saving in cost had the government dredged the 181,873,125 cu.yd., which were let by contract, would have paid for all the dredging equipment at present owned by the government.

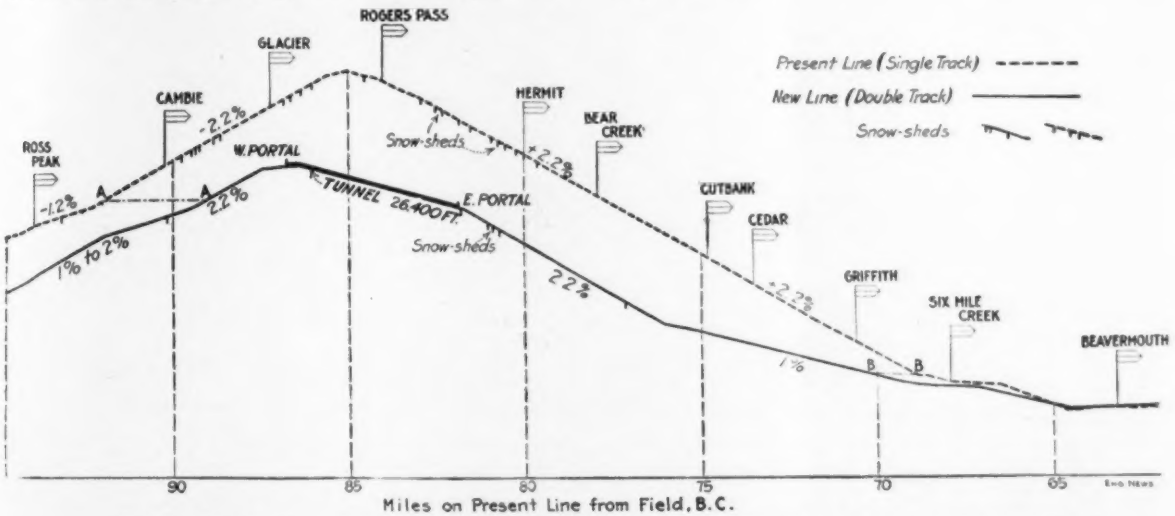


FIG. 2. PROFILES OF THE OLD AND NEW LINES AT THE ROGERS PASS; CANADIAN PACIFIC RY.

(At A-A and B-B the new double-track line is on the same location as the present single-track line; the differences in distances indicate the saving by the new line.)

The Status of the Telephone Industry in the United States has recently been reported for 1912 by the U. S. Bureau of the Census. The figures in the accompanying table include the total wire mileage and number of instruments for all systems in operation in 1912, but not including private lines between departments of an establishment unless connected to an outgoing line. It is reported that while the number of messages is accurately accounted for by some companies, no records are made from which accurate statistics can be compiled for the country. Moreover, a message may represent a few words' talk or a long conversation, and therefore does not indicate the extent to which the equipment is used. No estimate was possible of conversations over private-branch lines or for companies in 1912 which had an income of less than $5000.

	Year	Miles of wire	Number of telephones	Estimated number of messages or talks.[1]
United States	1912	20,248,326	8,729,592	[2]13,735,658,245
	1907	12,999,364	6,118,578	[2]10,400,433,958
	1902	4,900,451	2,371,044	5,070,554,553
Bell telephone system	1912	15,133,186	5,087,027	9,133,226,836
	1907	8,947,266	3,132,063	6,401,044,799
	1902	3,387,924	1,317,178	3,074,530,060
All other companies and systems	1912	5,115,140	3,642,565	4,602,431,409
	1907	4,052,098	2,986,515	3,999,389,159
	1902	1,512,527	1,053,866	1,996,024,493

[1] The number of messages reported by the Bell Telephone System includes only completed calls, while the figures for all other companies may include some original calls not necessarily completed; such as calls that the operator reports as "Line busy" or "Does not answer."

[2] Exclusive of companies with an annual income of less than $5,000.

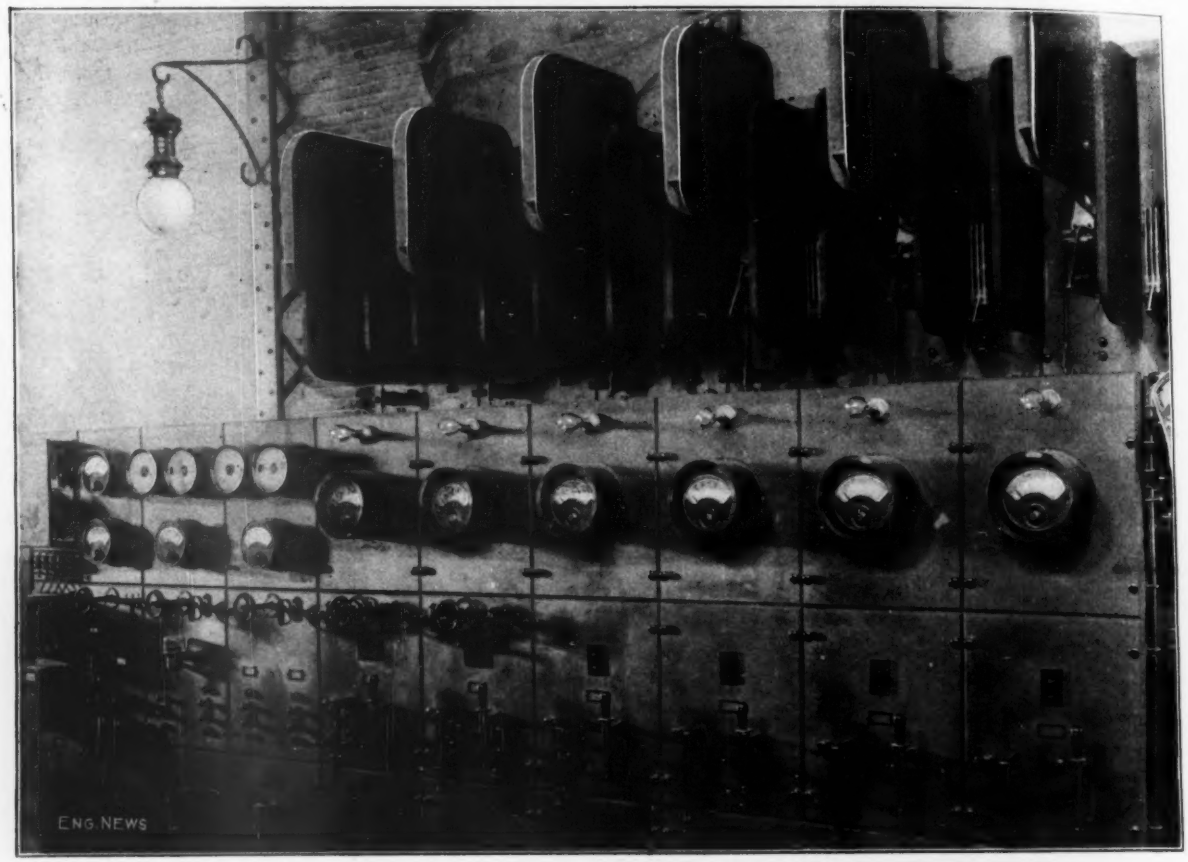
The First 2400-Volt Direct Current Railroad Switchboard*

The first 2400-volt direct-current switchboards built in America have recently been placed in regular service in two substations of the Butte, Anaconda & Pacific Ry., in Montana. As noted in the description of overhead line construction for this road (ENGINEERING NEWS, Mar. 19, 1914) there are two substations for converting the high-tension alternating current received to 2400-volt direct current for the railway motive power. In each substation there are two 1000-kw. motor-generator sets, each motor driving two 500-kw. 1200-volt direct-current generators connected in series to give 2400 volts, excitation current at a potential of 125 volts being furnished by separate exciters.

The alternating-current control is along the usual lines for remote-control switching, but the control of the direct-current ends of the machines brings several new and very interesting features. The high-voltage direct-current generators are protected from injury in the case of overloads and short circuits by a special circuit breaker developed for use in 2400-volt direct-current railway service. A notable feature of this circuit breaker is the use of an arc chute provided with a magnetic blowout of great intensity, the pole pieces of the blowout coil being designed with broad wings to distribute the magnetic flux uniformly over the whole arc chute, thus insuring that the direct-current arc will be ruptured when the circuit breaker opens.

Protection against too low voltage conditions is secured by a low-voltage release on the breaker. This also acts in conjunction with a speed-limiting device on the corresponding machine to trip the circuit breaker when the desired speed is exceeded.

The low-voltage release must be set before the breaker will remain closed; this is accomplished by lifting a plunger by means of a wooden rod connected through a bell-crank mechanism to an operating handle on the front of the switchboard, the handle being pushed toward the switchboard. The breaker may be tripped manually by pulling the operating handle out. The circuit breaker is also provided with a bell-alarm switch which closes the bell circuit when the breaker opens, the circuit being opened again as soon as the main switch is closed.



HIGH-TENSION DIRECT-CURRENT SWITCHBOARD AND CIRCUIT BREAKERS, BUTTE SUBSTATION; BUTTE, ANACONDA & PACIFIC RY.

Both the low-voltage release and a reverse-current relay are connected in the 2400-volt circuit through high resistance and are insulated from the circuit breaker so that the speed-limit device on the generator may be kept at ground potential.

The lever switches and circuit breakers are mounted on insulators, thus providing effective insulation. Large clearances have been allowed for all current-carrying parts. The main busses are located above and to the

*From information furnished by the General Electric Co., Schenectady, N. Y., designers and builders of the equipment.

rear of the circuit-breaker panels (the latter being located back of the panels carrying the instrument and metering equipment) and are protected by an asbestos lumber covering which inclines upward from the top of the circuit-breaker panels to the wall behind the switchboard, forming an effective barrier between the circuit breakers and busses. This construction accomplishes a double purpose, both preventing circuit-breaker arcs from reaching the busses and also making it impossible for anything to fall on the busses from above.

In order to insure the safety of the operator, there are no high-voltage live parts exposed on the front of the panels. The lever switches and circuit breakers are mounted on separate panels back of the main switchboard, as stated above, and are operated by handles, on the front of the main panels, acting through wooden rods and suitable mechanisms to insure that the handles shall be perfectly insulated. The ammeters are incased in insulating covers; the voltmeter, mounted on a swinging bracket, is connected directly to the circuit on the grounded side, with separate resistance on the positive side, thus making the potential from meter to ground a minimum. There are no live parts exposed on the back of the board from which the operator might receive an accidental shock. The shunt and potential leads are being carried through fiber tubes on insulators; potential receptacle studs are covered with a fiber box.

TRANSPORTING A DINKEY ENGINE BY CABLEWAY

Moving a 16-Ton Locomotive by Cableway at the Arrowrock Dam

The stationary cableway shown in the accompanying cut is one of two Lidgerwood cableways of the Arrowrock Dam construction plant. The view shows a 16-ton dinkey locomotive being transported from the pit to the spillway of the dam, which is situated 20 miles above Boise, Idaho. The span of these cableways is 1300 ft., and each has a continuous-capacity rating of 8 tons. The "Excavation for the Arrowrock Dam" was described in an extended article by Charles H. Paul, Construction Engineer, of the U. S. Reclamation Service, in ENGINEERING NEWS, July 17, 1913, p. 93.

Water Control in Illinois, including jurisdiction over public waters and public water-supplies, is exercised in some degree by seven different State bureaus, according to a paper by Prof. John A. Fairlie (Director of the Efficiency and Economy Commission of the State of Illinois, Champaign, Ill.) read before the recent convention of the Illinois Water Supply Association. These bodies are: The State Board of Health, the Game and Fish Conservation Commission, the Natural History Laboratory, the State Water Survey, the State Geological Survey, the Rivers and Lakes Commission, and the Public Utility Commission. In addition, there are various drainage authorities, some of which cover a number of minor civil divisions. The most important of these are the Sanitary District of Chicago and the East Side Levee and Sanitary District. Still further, the various cities and towns throughout the State have a considerable measure of local control over water and water-supplies. Although there is some cooperation between the seven bodies named, there is very little coördination and none of them has efficient control over local authorities. The State Water Survey, which dates from 1897, was created, Professor Fairlie says, "to make a chemical and biological study of water-supplies in the State for domestic and manufacturing purposes." In 1911 the work of the State Water Survey was so extended as to enable it to employ field agents to "inspect water-supplies and to make sanitary investigations and analyses of water." The Rivers and Lakes Commission was established in 1911 and was given jurisdiction and supervision over the rivers and lakes of Illinois. It has authority to collect data relating to public waters, navigation, water power, floods and various other subjects under authority granted in 1913. To quote again from Professor Fairlie: "Plans for works in public water must be submitted to and be approved by the commission." The commission has collected many data and published some reports on water resources, reclamation, navigation and harbor projects. Professor Fairlie states that "a few plans for drainage and sewerage work have been submitted to the Commission for approval." The State Public Utility Commission, organized at the beginning of 1914, "has jurisdiction over all private corporations or individuals owning or operating water or power plants" but not over municipal plants.

Large Steam-Shovels for Stripping Coal Seams

SYNOPSIS—Exceptionally large steam shovels of the revolving type have been designed for the special work of stripping coal seams for open-pit coal cutting. The machine here described weighs 270 tons and has an 8-yd. bucket on an 80-ft. boom. It travels on a pair of tracks, and is claimed to have excavated earth at a cost of between 2 and 3c. per cu.yd.

A class of excavation work which has developed to a considerable extent in recent years, and has provided a special field for the steam shovel, is that of stripping the overlying material from coal seams which lie nearly horizontal and are covered by overburden of not more than 30 ft. in depth. The usual method of operation in such stripping work is to make successive parallel cuts. The material excavated from the first cut is piled on the ground at the edge of the cut. The coal is removed by a small traction shovel working behind the big machine as shown in Fig. 2. On the next cut the big shovel deposits its spoil in the pit made by the first cut and that from the third cut is thrown into the pit of the second cut, and so on until the entire area has been covered. This makes the cost of digging the only expense in the removal of the overburden. Such stripping work is being done in the coal regions of Indiana, Illinois, Iowa, Missouri, Kansas and Oklahoma.

FIG. 1. OPEN-PIT METHOD OF MINING COAL; TWO RIVERS COAL CO., ILLINOIS
(The large steam shovel is removing the overburden, while the smaller one is excavating the coal.)

For some work of this class, special excavators with conveyors have been used, but the greater part of it has been done with steam shovels. Interest centers in the very large machines, particularly as the minimum cost per yard of material handled is usually attained with them. Some of the largest machines have been built by the Marion Steam Shovel Co., of Marion, Ohio, and these are described below from information furnished us by the company.

The steam shovels built by the Marion Co., for this work, are of the revolving type, in which the machinery is carried by a turntable revolving upon the lower fixed frame. They are very much larger than the ordinary revolving shovels; have long booms and are much heavier and more powerful than steam shovels of the ordinary non-revolving type on standard-gage track. The largest of the Marion machines weigh about 270 tons, and can handle an 8-yd. bucket on an 80-ft. boom or a 5-yd. bucket on a 90-ft. boom. One of these, with an 8-yd. bucket, is shown in Fig. 1. It is operated by the Two Rivers Coal Co., near Danville, Ill., and the view shows it making a cut 24 ft. wide in overburden 20 to 30 ft. deep, the material comprising 10 ft. of soapstone and 10 ft. of sand and loam. The length of cut is about ¼ mile. Four men are employed on the machine and from four to six men in the pit, for shifting track, etc. The Beech Flats Coal Co., at Rush Run, Ohio, has a similar 270-ton machine with an 8-yd. bucket and 80-ft. boom. This is making a cut 80 to 106 ft. wide, working in sidehill ground where the depth of overburden is from nothing to 24 ft.

A smaller machine operated by the Pierce Coal Co., in Kansas, is shown in Fig. 3. This has a 75-ft. boom with 3½-yd. dipper, and weighs about 175 tons in working order. It cuts to a radius of 52 ft. at grade or 88 ft. at a height of 34 ft., and has a horizontal reach of 83 ft. from the center of the turntable to the center of the dump. The bucket can dump at a height of 53 ft. above the rail, with the boom at an angle of 45°.

The builders state that it is difficult to give figures as to performance and cost per cubic yard owing to the fact that the materials vary greatly, as well as the speed of working by different crews, while the cost-keeping methods in use among the coal operators rarely give an accurate accounting. The company has figures, however, which show that some operators are moving the overburden at costs as low as 2.3 to 2.6c. per cu.yd. The capacity of the machines ranges from 2000 to 3500 cu.yd. per day, varying with the size of the machine and the character of the material excavated.

The following description relates to the 270-ton shovel, shown in Figs. 1 and 2.

FRAME AND TRUCKS—The lower or fixed frame is square and is built up of four 56-in. plate-girders and 30-in. diagonal corner beams, with eight 24-in. radial beams riveted to a central steel casting which carries the turntable-pivot pin. Upon this lower frame is the lower roller path of the turntable.

The upper or revolving frame is longer and narrower than the lower frame, with the engine and hoist mounted over the pivot pin and the boiler mounted on the rear

overhanging end so as to act as a counterweight to the boom. The frame is built of I-beams and channels, and to its under side is attached the upper roller path of the turntable. It carries the housing or cabin, with a hinged platform at the rear to serve as a platform for the fireman. The frame is stiffened by a pair of trusses, with transverse A-frame so designed with pin connections that the upper part can be dismantled and assembled in the field with a minimum amount of work. The A-frame carries the pulleys over which is led the topping lift of the boom.

The upper frame revolves around a heavy pin carried in steel center castings in the upper and lower frames. The turntable consists of upper and lower roller paths, secured to the revolving and fixed frames respectively, these roller circles being 30 ft. diameter and having between them a live ring of 60 high-carbon cast-steel rollers 11½ in. diameter, with journals carried by inside and outside rings. Each roller has grease cups to lubricate its bearings. To the lower or fixed frame is attached the horizontal circular rack for revolving the upper frame.

The lower frame is carried on four trucks, each having four double-flanged 30-in. wheels. The machine travels on two tracks of 39-in. gage, spaced 26 ft. c. to c. Each truck has a single inside frame of cast steel which carries the king pin and in which the axles have bronze bushed bearings. The axles of all the trucks are utilized for propulsion, being driven by gearing. A hollow vertical shaft at the center of the frame is driven from the main engine and carries a pinion gearing with a bevel gear on a longitudinal shaft, which in turn is geared to two lateral shafts carrying pinions gearing with spur wheels on the inner face of the truck wheels. The shafts have telescopic and universal joints, so that the machine can travel on curves and irregular tracks.

A special feature of the carrying system is the hydraulic equalizing or leveling device provided for the two rear trucks, which gives the flexibility of a three-point support and enables the machine to travel and be operated on uneven track without imposing torsional strain in the frame due to unequal distribution of the load. The device consists of a pair of hydraulic cylinders in the frame, with large trunk pistons which have a bearing upon the truck frames. These are connected to a pump by heavy pipes fitted with valves and a bypass, so that the fluid may be allowed to flow from one cylinder into the other or into the pump reservoir.

MACHINERY—The hoisting engine is of the horizontal side-crank type, with two cylinders 14x16 in. and link reversing gear. The cylinders with their bedplates are cast separately and are mounted on opposite sides of the bedplate of the hoist, whose frame carries the main drum shaft and the intermediate or clutch shaft. The throttle is of the balanced-piston type, having long tapering ports to admit steam gradually to the cylinders, and having a bypass which enables the engine to back down (with a loaded dipper) by releasing the steam from the cylinders while the hoisting friction is still engaged.

The 38-in. hoisting drum is mounted loose upon its shaft, and has bronze-bushed bearings. Its length is such that only a single wrap of the cable is required to raise the dipper to its highest position. The drum is operated by an outside friction band, lined with wood blocks, and controlled by a cylinder which is bolted to the spokes of the main gear wheels and is connected to the band by a lever keyed to a crank passing through the gear near the rim. Opposite the main friction band is a check band for controlling the dipper when the main friction is released. This also is of the outside type, of large diameter and wide face, with an air-cooled housing. It is operated from the forward end of the machine by a foot

FIG. 2. 270-TON REVOLVING STEAM SHOVEL WITH 8-YD. DIPPER FOR STRIPPING COAL

lever connected to toggle links, which gives an effective checking brake while allowing ample clearance on the housing when the band is released.

The 15-in. boom hoisting drum is mounted on the rear end of the machinery frame, between the engine cylinders. It is driven by a clutch on the intermediate shaft, engaging a worm gear which locks the boom in any position without the aid of ratchets or friction bands.

The rotating engine is of the horizontal center-crank type, with two cylinders 10x11 in.; it is reversed and controlled by a central valve of the balanced-piston type, and requires but one operating lever. The two cylinders and single steam chest are in one casting, which is bolted to the bedplate; on this latter are formed also the crosshead guides and shaft bearings. The engine is compound geared to a vertical shaft whose lower end carries a pinion which gears with the fixed circular rack on the lower frame. This engine is set behind the main engine and to one side so as to bring the driving pinion in the longitudinal center line. With this arrangement, the teeth in mesh will not bind when there is any vertical play of the upper frame. The propelling gear is driven from the main engine through a clutch, as noted above.

The machine has two boilers of the locomotive type, 6 ft. diameter and 19 ft. long, designed for 150 lb. steam pressure but carrying a working pressure of 125 lb. The ashpan has a dump bottom, and an adjustable sliding door to regulate the draft. There are two water tanks, one on each side, and when the machine is working the tanks can be filled by means of a pipe leading through the hollow vertical shaft of the propelling gear.

Boom and Dipper—The boom is of steel, of box-lattice construction, but with long cover-plates on all four sides, at the middle and ends. The foot casting and socket are hemispherical, to allow of a slight rolling motion of the boom without straining it. The socket casting is connected to the inner sills and end crossbeams of the revolving frame directly over the roller path, so that the strain is transmitted directly to the lower frame. Cable guys attached to the middle of the boom are anchored to the corners of the upper frames so as to steady the boom in starting and stopping. The crowding engine is mounted on top of the boom and is of similar design to the rotating engine, but has cylinders 9½ in. It is geared directly to the shipper shaft, which runs in bronze bushings and is made of square section to carry the open-hearth steel gears and the manganese-steel shipper pinion.

The dipper handle is composed of two oak timbers with steel plates on the sides and heavy steel bars on the top and bottom. It is held to the shipper shaft pinions by a yoke or saddle attached to a cast-steel slide plate on top of the dipper handle, and has at its outer end a steel casting to which the dipper or bucket is attached by a pin. The rack is of manganese steel, secured to the lower face of the handle by through bolts.

The dipper has the front and front corners formed of a single manganese-steel casting, joined to the cast-steel back plate by steel side plates, which are reinforced at top and bottom. On the back-plate are formed jaws to which the dipper handle pitch braces and door hinges are connected by pins. The dipper is fitted with teeth which may be of manganese steel or of forged steel with tool-steel points, as may be required. The bail carries the steel sheave block, with steel sheave having a pin of large diameter which runs in bronze bushings and has a lubricating device.

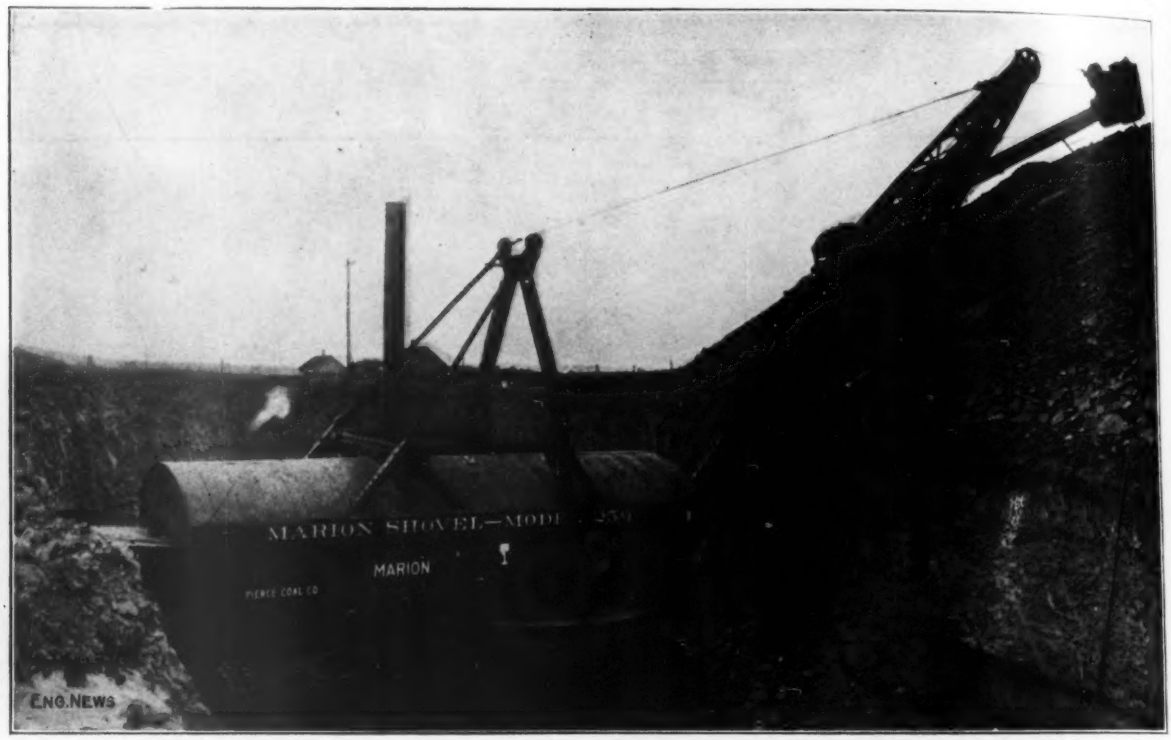


Fig. 3. 175-Ton Revolving Steam Shovel with a 3½-Yd. Dipper on a 75-Ft. Boom. Pierce Coal Co., Kansas

The steel hoisting rope is triple-hitched to the dipper, passing over double sheaves at the head of the boom and through the boom to the drum. The boom-hoist rope passes through a block at the head of the boom and over a sheave on the A-frame, thence direct to the drum. The engineman is stationed at the front end of the revolving frame, and to the left of the boom so that he is in close view of the work. Here are grouped the six operating levers which control the following functions: the hoisting throttle, the main drum friction, the boom hoist and propelling clutch, the hoist reverse, the cylinder cocks, and the check or brake band, this last being a treadle or foot lever. The craneman is stationed at the right-hand front corner of the revolving frame.

The accompanying table gives some of the main particulars of these large steam shovels.

Bucket	8 yd.
Length of boom	90 ft.
Height of dump above rail	65 ft.
Radius of cut at 40 ft. elev.	103 ft.
Radius of cut at grade	59½ ft.
Reach from pivot to center of dump	95 ft.
Pivot to rear end of upper frame	36 ft. 6 in.
Height from rail to top of A-frame	47 ft. 6 in.
Size of revolving frame	21x50 ft.
Size of lower frame	30x30 ft.
Water-tank capacity	3200 gal.
Working weight	270 tons
Ballast for upper frame	15 to 20 tons
Hoisting cable	1¼ in.
Boom hoist cable	1-in.
Length of dipper handle	48 ft.
Diameter of hoisting drum	38 in.
Diameter of boom-hoist drum	15 in.

Provisions for Dragging Roads under the New Iowa State Highway Law

As described in our issue of July 17, 1913, in an article by Prof. A. Marston, Chairman of the Iowa State Highway Commission, the new state highway law, passed in 1913, provides that the commission shall have supervision of all road officers and all road work in the state. The new law is radically different from the old laws and has come to be considered a model for state highway organization in other states. Although there were between 8000 and 9000 road officers, state, county and town, in Iowa at the time the law went into effect, far less difficulty has been met with in perfecting the organization than was anticipated.

One of the difficulties to be solved was to organize the township road work to get the most efficient results possible in widely scattered and much neglected localities—a branch of road work that in most states still comes outside the pale of engineering supervision. Engineering supervision of maintenance of common dirt roads, as has been noted in these columns before, consists largely in the effective and judicious use of the common road drag. This is now provided for in Iowa by state law, an abstract of the provisions of which follows:*

Township Trustees—It is made the duty of the township trustees to select what are known as the draggable roads of the township and to select one man as superintendent of the township road system at the annual February meeting, or as soon thereafter as possible. Upon the roads selected as draggable by the trustees is spent for dragging, not less than the one mill drag tax authorized by law. No part of this drag fund is spent for equipment or for pay of the township road superintendent.

The trustees have all bills, for work done on the township roads, certified to by the township road superintendent before allowing payment. The trustees fix the term of employment, compensation and bond of the superintendent and require an annual report of work done and moneys spent by him. The purpose of this report is to make the work done a matter of record and to insure that the work will be done in such a manner that a good report can be made of the work done.

Township Superintendent—The township superintendent has charge of all the dragging and repair work on the township road system. He makes sure that the approaches to all bridges and culverts on the township roads are kept in shape and all trash and weeds kept from choking the mouths of culverts and bridges. He makes contracts for dragging and sees that dragging is properly and promptly done.

Road draggers are paid, from the dragging fund, a reasonable price for the work.

The superintendent of the township roads has charge of the work of the poll tax of the township by directing the work done in paying the tax.

He certifies to the correctness of all bills for dragging, maintenance and repairs. These bills are itemized as to time, place and amount of work done. Without this certification the township clerk cannot draw warrants without becoming liable on his bond for the amounts so illegally drawn.

The superintendent's compensation comes out of the township road funds, which is kept separate from the drag funds. All drags and other equipment are also paid for from the road funds and not from the drag fund.

The superintendent makes a full and complete report annually of the work done by and under him showing itemized cost, location, time and by whom done. This report is made to the township trustees.

Highway Engineer—The county is required to furnish a civil engineer free to the townships for permanent grading work. Before beginning any work upon the township road system, other than that described as repair work, the trustees must make application to the board of supervisors, who are required to furnish them with an engineer, to be paid out of the county fund, who shall survey and lay off such roads according to the plans and specifications.

The foregoing provides for the supervision of drag work, which is best done by written contract, the agreement being worded as follows:

COPY OF DRAGGING CONTRACT FOR COUNTY HIGHWAYS IN HENRY COUNTY

I hereby agree to drag the following highway whenever necessary, or when directed so to do by the Supervisors for the period of one year commencing January 1st, 1914, for the consideration of 35 cents per mile, traveled, commencing at .....and ending at.....
being.....miles in all.

I further agree to ride said drag, to remove all loose stone or sticks from the traveled portion of the highway and carry a shovel and make any small repairs at culverts and bridges, to remove any bumps or accumulations from said highway; also to remove any grass, weeds, or other accumulations from culverts and bridges so as to give water a free passage through same.

I further agree that if I neglect said road at any time when the same needs dragging or refuse to drag it when called upon to do so, that I will forfeit the sum of 50c. per mile of said highway neglected.

The Board of Supervisors reserve the right to cancel this contract at any time.

....
Contractor.
.....
Supervisor.

Electricity for Heat, and for all other services involving the use of energy, will be used in a new high school building at Rupert, Idaho, in the center of the Minidoka Irrigation Project. For the general heating apparatus, the common arrangement of hot-air pipes, etc., has been adhered to, but the heat is furnished by a battery of electrical units, similar to those used in large ovens. Twenty 18-kw. units are to be installed in pairs, each pair having a separate control from a switchboard in the principal office. Current comes from the Project power house, 14 miles away, and the estimated cost of operation is placed at $1760 a year compared with coal supply at $1000 plus a fireman at $75 per month. The first cost of the electric system was $3000 less than the other. The equipment was planned by local electricians, with the assistance of the government engineers on the Project. In addition to the heating, a 10-hp. motor drives a ventilating fan and supplies power for the manual training department. An electric hot-water heater supplies the domestic science department, the shower baths, lavatories, etc. In the domestic science laboratory are individual electric stoves, an electric range, and various appliances. The electric lighting includes a small theater equipment for the school auditorium, the building also serving as a social center.

*From the Service Bulletin of the Iowa State Highway Commission, February, 1914.

Recent Improvements of the Boston & Maine Railroad in the Connecticut River Valley

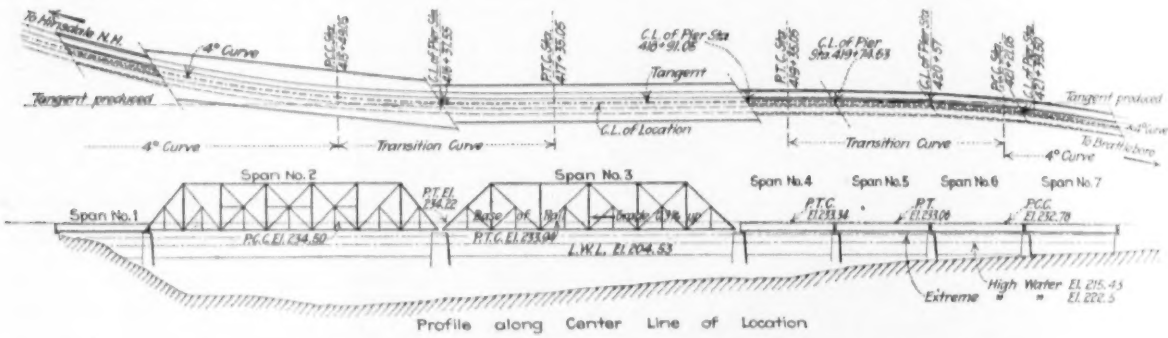
The Boston & Maine R.R. has been doing work for some two years on its line near Brattleboro, Vt., which will, when completed, materially change the arrangements in this locality and represent the investment of $3,000,000 or more. The work is best examined under three heads: (1) The Hinsdale cutoff; (2) the Brattleboro station and approaches, and (3) the checking of slides at East Putney, Vt., the last being a project of minor size though of considerable interest.

THE HINSDALE CUTOFF—For many years the Boston & Maine trains proceeding north from Springfield, Mass., have had to run over Central Vermont Ry. tracks between South Vernon, Vt., and Brattleboro (a distance of 11 miles), and again between Windsor, Vt., and White River Junction (14 miles). It has long been the aim of the Boston & Maine R.R. to make its own line continuous so far as local topography would permit and in accordance with this policy a double-track cutoff was planned to get around the Central Vermont section between South Vernon and Brattleboro.

Opportunity was taken of the generally flat lands on the New Hampshire side of the Connecticut River between these two places. Also the Boston & Maine has a line, called the Ashuelot branch, running from South Vernon, Vt., to Keene, N. H., crossing the Connecticut just above the former place. This branch, therefore, was used as the beginning of the new cutoff. The Ashuelot branch was left, after going three miles from South Vernon, at Dole's Junction, and the new line is pushed north along the river. About a mile below Brattleboro the line is brought back into Vermont over an interesting bridge.

The cutoff has a few curves of 1° or less, one 3° and one 2°. At the Connecticut River crossing where the line reënters Vermont, there are three 4° and one 2° reverse curves with short tangent stretches between. Maximum grade is 0.5%. The line up to the Connecticut crossing is a succession of short cuts and fills, totaling as follows: Earth cut, 1,360,000 cu.yd.; ledge, 130,000 cu.yd.; fill, 1,092,000 cu.yd. The excess cut was used on the approaches into Brattleboro on the Vermont side of the river.

The only difficult piece of work on the cutoff was at Fort Hill on the New Hampshire side, where a cut of some 85 ft. maximum had to be made. The material proved to be a saturated clay mixture which slid easily and afforded poor support for the track shovels and men. It was necessary to broaden the excavation in a series of short steps and to attack the hill from the outside slope. Also excavation was made by crane and clam-shell bucket to 4 ft. below grade and filled with cinders and gravel. Since the material has had opportunity to drain itself there has been no difficulty with slides.



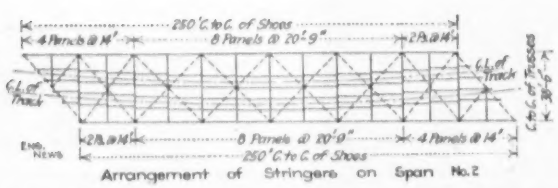
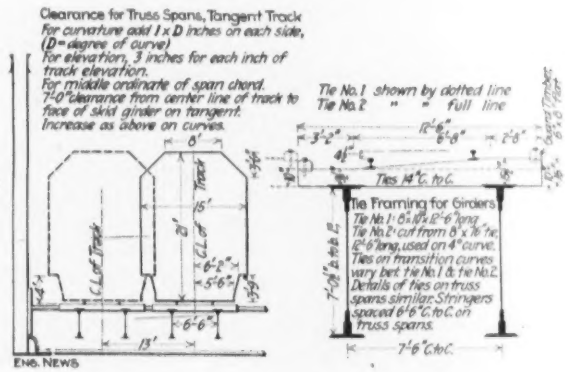


FIG. 1. CONNECTICUT RIVER CROSSING OF THE BOSTON & MAINE R.R. NEAR BRATTLEBORO, VT.


Clearance for Truss Spans, Tangent Track
For curvature add 1 x D inches on each side, (D = degree of curve)
For elevation, 3 inches for each inch of track elevation.
For middle ordinate of span chord.
7'-0" clearance from center line of track to face of skid girder on tangent.
Increase as above on curves.
Tie No. 1 shown by dotted line
Tie No. 2 " " full line
Ties 14" C. to C.
Tie Framing for Girders
Tie No. 1: 6 x 10" x 12'-6" long
Tie No. 2: cut from 8" x 16" tie, 12'-6" long, used on 4° curve.
Ties on transition curves vary between Tie No. 1 & Tie No. 2.
Details of ties on truss spans similar. Stringers spaced 6'-6" C. to C. on truss spans.
7'-6" C. to C.
ENG. NEWS

For all this work the contractors, Holbrook, Cabot & Rollins Corporation, came in from the south on 20° curves and 5% grades with standard-gage equipment. To provide outlets for the excess of cut over fill, the river was crossed on trestle just above the site of the new bridge. A few difficulties were encountered with this trestle in spring high water, but the ice dams were broken up before the work was lost. Work was started April, 1912, and the line was opened for traffic June 23, 1913.

The new bridge over the Connecticut has two 250-ft. two-track truss spans, four 80-ft. single-track girder spans for each track, and one 82½-ft. girder span, as shown in the accompanying figure. The east abutment is in ledge. Pier 1 was built with a coffer-dam on ledge. Piers 2 and 3 were built with open caissons sunk to gravel and resting on piles. Piers 4, 5 and 6 were built with coffer-dams in gravel. The west abutment was a coffer-dam in gravel and on piles.

The line enters the bridge on a 4° curve which is car-

ried past the middle of the first truss span. The second truss is on transition curve and tangent. The reverse transition begins about the middle of the fourth girder span and is carried past the middle of the sixth span where the 4° curve is taken.

Four and six feet above the ties are two skid girders built into the truss. The tie framing is unusual, as seen

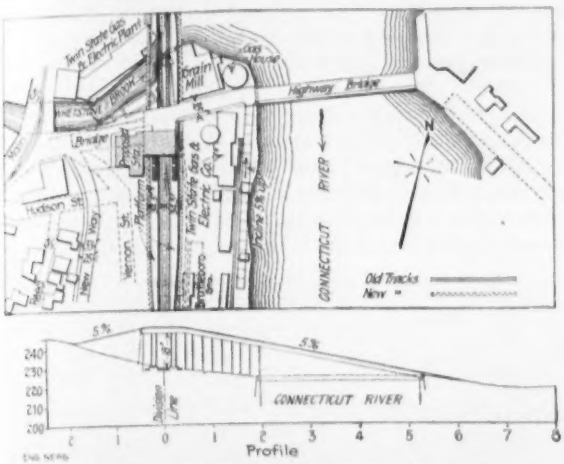


FIG. 2. LAYOUT OF NEW BRATTLEBORO STATION AND BRIDGE ST. CROSSING

in the accompanying figure. The steelwork was built and erected by the American Bridge Co. The erection was on falsework.

The river bank from this bridge north into Brattleboro is narrow and flanked by a high bluff. Therefore, right-of-way for the track approaches from the bridge into the town were secured from the Central Vermont Ry. In exchange, rights were given the latter road from Brattleboro north a mile to the junction with the Central Vermont branch to South Londonderry (recently converted from narrow to standard gage). As the Boston & Maine here is double tracked (the Hinsdale line is built for two tracks, but only one is laid at present), it was necessary to fill in the river bank above and below the town, part of the material coming from the excess of cut on the Hinsdale line as already noted. Much of this fill along the river bank has been riprapped, as the Connecticut River here is virtually a long lake on account of the back water of a recent hydro-electric development just below.

BRATTLEBORO STATION—At the instigation of the Vermont Public Service Commission, improvement of station facilities and elimination of the bad grade-crossing at Brattleboro are being carried out with the other work in this vicinity. Bridge St. (as shown in the accompanying figure) is to be carried over the railroad yards on a viaduct and the new station is to be built on the viaduct level with stairs descending to the train platforms below. This work involves raising the present highway bridge across the Connecticut and resting it on a grade in place of its present level position. An incline will be necessary near the water front down to the Boston & Maine freight house which will replace the existing Union passenger station. The Central Vermont freight house will be west of the main-line tracks.

A feature of the rearrangement is the abandonment of the old Vernon St. which descended to the tracks as shown, and cutting a new alignment for it out of a ledge some 50 ft. high, the old face being taken away for some 75 ft. maximum depth. This has involved 108,000 cu yd. of earth excavation and 6400 cu.yd. ledge. The relocation of Vernon St., the construction of retaining walls, and the fill for the Central Vermont freight yard are now practically completed. The matter of grade crossing separation is still waiting for final agreement with the town and consequent order of the Public Service Commission covering final details of plans and the actual construction.

EAST PUTNEY SLIDES—A couple of miles above Brattleboro, at East Putney, Vt., where the old road followed the river bank on a 3° curve, trouble was encountered by the old bank sliding. The bank had sloped to the river at less than 1½ on 1 and had been stable until the Hinsdale hydro-electric development was completed below. It is probable that the bank became more saturated at the new backwater level (13 ft. above low water) for when this was suddenly drawn down in releasing flood flow, the bank slid away from under the track.

In repairing the line the bank was filled out into the river more and the curvature reduced a little. In filling, rock was dumped in against the bottom toe, as shown in the accompanying sketch, to backwater level. Above this

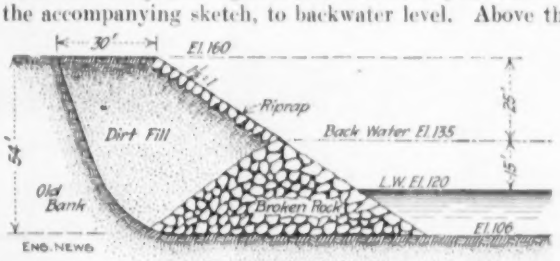


FIG. 3. REPAIR OF EAST PUTNEY SLIDES, B. & M. R.R.

was a dirt fill bringing the bank out 30 ft. The back fill was protected by riprap stone from the new station excavation in Brattleboro.

All this work above noted has been done under A. B. Corthell as Chief Engineer of the Boston & Maine R.R., F. C. Shepherd as Engineer of Construction, and H. L. Farwell as Resident Engineer. The Hinsdale cutoff project was initiated, however, by J. P. Snow, then Chief Engineer of the Boston & Maine.

The Manchester Ship Canal, which has now been operating for 20 years, carried last year 5,780,000 tons of toll-paying freight. The canal has fully met the expectations of its promoters in that it has made Manchester an important sea port, the fourth in volume of traffic in Great Britain. Financially, however, the enterprise has been a complete failure. Last year was the first since the canal was opened that there has been any balance left after paying operating expenses, rentals and interest on bonds. Out of this margin, which amounted to $150,000, the directors allotted $100,000 to pay a dividend of 2¼% on the stock held by the city of Manchester. Further than this, according to the London "Engineer," there is no likelihood of any dividends for the ordinary stockholders in the near future, even should there be further large increases of traffic, for the capacity of the canal's terminals is now taxed to its limit and further capital must be provided to build additional docks and warehouses.

Of the ocean ship canals of the world the Suez Canal is the only one, so far as we now recall, which has ever yielded direct profit to those who invested money in its construction. However, with the exception of the Manchester and the Suez canals, practically all the other ship canals of the world have been undertaken as a governmental or municipal enterprise, and direct profit from the earnings has been a secondary consideration.

Reconstruction of Canadian Pacific Bridge over the St. Lawrence near Lachine

The renewal and double-tracking of the Canadian Pacific Ry. bridge over the St. Lawrence River near Lachine Rapids, about 7 mi. above Montreal, was finished a few months ago.* The old single-track bridge was replaced by two parallel single-track bridges designed for very much heavier loading. In place of the interesting four-span continuous structure which formed the channel crossing of the old bridge, simple spans are used in the new bridge. To put these in place without using falsework, the end-launching method was employed, each channel span being built on the deck of the flanking span, with forward end overhanging, and then shoved forward with the use of a scow under the forward end and a sliding-truck under the rear end.

The other spans were built on light temporary trusses, which could be set in place bodily without use of falsework. In the case of the longer of these spans, too long for the temporary trusses, a single falsework bent or tower was built at midspan, carrying the outer ends of two spans of temporary trusses.

At no time during the reconstruction was traffic carried on falsework.

The old single-track bridge (Fig. 1) was built 1885-1887. C. Shaler Smith designed the superstructure, and the Dominion Bridge Co. built and erected it. R. G. Reid & Co. built the piers. The two channel spans, each 408 ft. long, were made through spans with clearance of 60 ft. above high water for navigation. All other spans were deck spans, 80 to 270 ft. long. The channel spans connected to the adjacent 270-ft. spans with curved connecting chord-pieces, making the four spans continuous. The loading for which the bridge was designed (approximately E35 engines and 2500-lb. train) is only about half that of present-day bridge design.

By 1910, the load limitations of the old bridge and the need for double track called for renewal. Designs for the new structures were made by the railway company's engineer. The Foundation Co., Ltd., did the substructure extension, and the Dominion Bridge Co. built and erected the new steelwork and removed the old.

One of the two new bridges coincides with the old one in alignment, while the other is 27 ft. (c. to c.) downstream at the channel spans, and 16 ft. 4 in. at the north abutment, the tracks being drawn together in the northerly half to save expense in the piers. This new downstream bridge is so close to the old one that its piers are mere extensions of the old piers. Four new piers were built for both bridges, however, dividing four of the old spans (240 ft.) into eight (120 ft.), as ice movement in this part of the river has been found to be so light that the larger openings are not required, and the shorter spans give a cheaper bridge.

The pier work, both extending the old piers and building the four new ones, was done with open coffers, except for the five piers in deepest water, where pneumatic caissons were used. Wing dams upstream of the piers stilled the water at the work. One of the channel piers (No. 13) has its extension sunk 7 ft. lower than the old pier, as the shale found at the old footing was not considered proof against settlement. Above water line the new masonry of each pier is bonded to the old, and for avoidance of cracking at this bond full assurance against settlement of the new masonry was requisite.

The new bridge has the following spans, beginning at the north end:

3—80-ft. deck plate-girders.

FIG. 1. OLD SINGLE-TRACK BRIDGE, BUILT 1885-1887, REBUILT 1911-1913

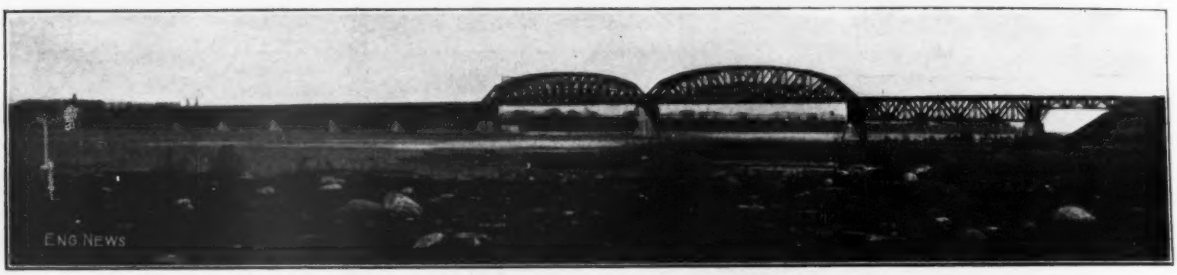


FIG. 2. NEW DOUBLE BRIDGE, JUST COMPLETED

(Both views taken looking downstream from Caughnawaga or right bank.)

OLD AND NEW CANADIAN PACIFIC RY. BRIDGE OVER THE ST. LAWRENCE RIVER NEAR LACHINE

*An excellent summary of the work was given by P. B. Motley, Bridge Engineer of the Canadian Pacific Ry., before the Canadian Society of Civil Engineers, Feb. 5, 1914. This is followed in the present review.

8—120-ft. deck Warren trusses (these were four 240-ft. spans in the old bridge).
4—240-ft. deck Warren trusses.
1—270-ft. deck Warren truss.
2—408-ft. through Pratt curved-chord subpaneled trusses.
1—270-ft. deck Warren truss.
1—120-ft. deck Warren truss.

The 270-ft. spans were designed not only for the railway load, but also for the loads from the 408-ft. spans to be erected on them, especially the reaction of the rear-end truck or buggy traveling across the span during the launching. All spans are rigid in makeup and detailing; all connections are riveted.

The superstructure work, both in design and in erection, was controlled by the vital necessity for maintaining traffic uninterrupted. This, in fact, led to the use of two single-track instead of one double-track bridge; the new downstream bridge could be erected and put into service, and then the old one taken down and the second new bridge built in its place.

This arrangement was modified, in actual application, to the extent of erecting a short length of the first new bridge, then connecting its outer end to the old bridge by a crossover—which was possible because the spans are of the deck type—then renewing the corresponding part of the old bridge while operating trains over the combination new-and-old structure by way of the crossover; and repeating this sequence. In this way the several items of the construction work progressed across the river regularly, and steel erection did not have to wait so long on the substructure work.

Erecting the Deck Spans

Erection began Mar. 15, 1911, at the north end. In two months the three 80-ft. and eight 120-ft. spans of the first new bridge were completed. The plate-girder spans were set in place assembled. The 120-ft. truss spans were erected on a light temporary span of the same length which was set without use of falsework. On May 28, 1911, the last two of the new spans were slid over into line of the old bridge, the corresponding 240-ft. old span being at the same time shoved upstream onto a pair of timber supports built for the purpose. This was done between trains, though with some delay. With the two new spans in the old bridge, the corresponding second pair of spans was erected and thus the downstream (first) bridge again completed for 11 spans. On the length of the 10th and 11th spans a crossover was now built (on long ties connecting the two decks), and then the traffic was operated over 9 spans of the new bridge and the crossover, and thence south over the old bridge (9 spans). This diversion of traffic was accomplished on July 6, 1911.

The old spans back of the crossover, being now idle, were taken down and the new spans built. At the same time, the 12th to 15th spans of the downstream (first) bridge were erected. This latter work, 240-ft. spans, employed the same 120-ft. temporary supporting spans as previously used, but two such spans were used, and a timber bent erected at midspan to support their adjoining ends. On Nov. 12, 1911, the four 240-ft. spans being finished, the forward end of the forward span was slewed over into line of the old bridge, and simultaneously the old span slewed over out of the way on falsework. This shift being made, trains were run over downstream bridge for 14 spans, thence over the slewed span to the old bridge. The crossover in the 10th and 11th spans could be removed, and the 12th to 14th spans of the second new bridge could be erected; this work was done during the winter 1911-1912. On Mar. 31, 1912, the slewed 15th span was shifted over wholly into the line of the old bridge, and traffic was again moved wholly over the old alignment.

Erection work on the first new bridge being resumed, the second span 15 (in place of the slewed and shifted one) was built, and work continued right ahead on the 270-ft. 16th span, flanking the channel crossing. For the 270-ft. span, the two 120-ft. temporary spans were again used, and the deficiency of length made up by 30 ft. of falsework at midspan, a 30-ft. trestle tower being built to support the temporary spans. The span was completed July 13, 1912. At the same time, in preparation for erection of the 408-ft. channel spans, work was started at the south abutment in spring of 1912. The 80-ft. girder and 270-ft. truss span here were completed on June 18, a month ahead of the north flanking span.

Erecting and Launching the Channel Spans

The two 408-ft. spans, as already mentioned, were erected on top of the 270-ft. flanking spans. Three panels

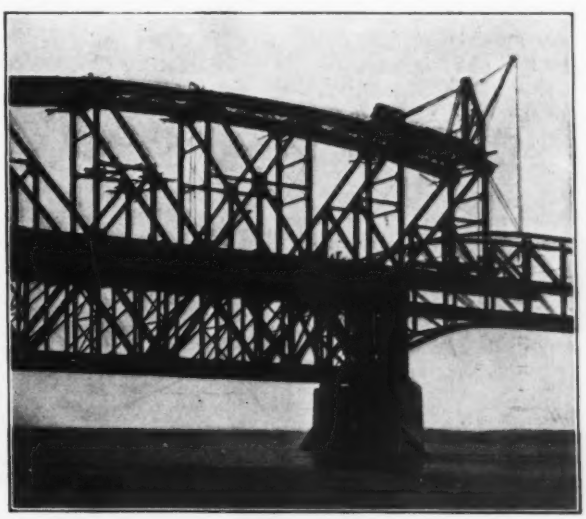


Fig. 3. New 408-Ft. Span Partly Erected on Deck of 270-Ft. Span; Downstream New Bridge, Old Bridge in Rear

(about 130 ft.) overhung on the channel side; these were cantilevered out from the main portion without difficulty. Both spans (17th and 18th) were completed in summer and fall of 1912, and by November were ready for launching.

These spans are of the subpaneled Pratt type, with top chords curved approximately to parabolic shape. The makeup and detailing are rigid throughout, as in fact necessary for the partial cantilever erection and the launching.

Launching Appliances—Skidways consisting of two sets of four 100-lb. rails were laid on the deck of the 270-ft. span under the channel span; the top face of the rails was well greased. This track supported a sliding truck or buggy carrying the rear end of the 408-ft. span, resting on the track by means of cast-steel skids or slippers. The buggy consisted of a special strut framework giving a three-point bearing on the track.

To carry the forward end of the span, a pair of scows

FIG. 4. LAUNCHING THE SOUTHERLY CHANNEL SPAN OF THE DOWNSTREAM BRIDGE

was placed under the overhang; trestle framing erected on these scows carried the truss at the fourth and fifth subpanel points. The double scow was 37x180 ft., with a displacement empty of 700,000 lb. The span to be moved weighed 1300 tons at time of launching. Its reaction on the scow amounted to 1,855,000 lb., and falsework and accessories made up 430,000 lb. more, the total loaded displacement being thus nearly 3,000,000 lb., which gave a draught of 84 in. loaded. Equalization of load on the two scows was made by four 100-ft. plate-girders on which the trestle support was built.

The scows were held by cable to a pilot scow a short distance upstream, which in turn was anchored to a deadman and some concrete blocks sunk upstream. A dynamometer in the cable at the main scow enabled the pull to be read. This was an important matter as the current in the river varied from five to eight miles per hour.

The actual moving was accomplished by a Lidgerwood unloader engine placed at the rear of the span to be moved, its cables running thence to near the forward end of the 270-ft. span and thence back to the moving span.

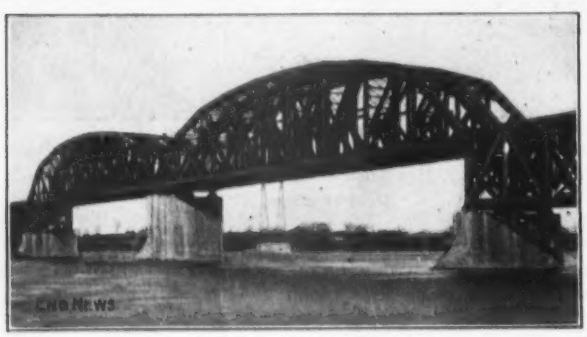


FIG. 5. THE FINISHED CHANNEL SPANS OF THE NEW BRIDGE

The span was started by jacks and the further movement controlled wholly by the winding engine. The cables between main and pilot scows were shortened as the span moved across in order to keep the span in the true line.

The southerly span (18), being completed first, was launched on Nov. 4, 1912. Three hours were required to move it to position over its piers, but of this only 1 hr. was actual moving time, the difference being accounted for by taking up slack of cables, etc., and by dismantling part of the rear-end buggy when the span was near final position, changing the buggy from 3-point to single-point bearing after the forward bearing ran off.

The northerly span of the first new bridge was launched in precisely the same way a few weeks later, Nov. 22, 1912. It was moved in ½ hr. less time, i.e., 2 hr. 30 min. gross, and 28½ min. net moving time.

The launching left the spans 12 ft. above final position, and they were lowered by 150-ton jacks and blocking. The end floorbeams had been designed specially strong for this operation.

Thus the first new bridge was completed in 1912. In 1913, work on the second or upstream bridge was resumed. Five spans had to be taken down and new ones erected. The dismantling began in April, 1913, and was completed early in June. The erection of the two 270-ft. spans (16 and 19) and the 80-ft. girder span (20), were followed by erection of the 408-ft. spans on the decks of the flanking spans, as for the first bridge, which work was completed by October.

The launching arrangements were, with one change, the same as for the long spans of the first bridge. The change was the abandonment of the pilot scows. The anchor cables were taken direct to the scows on which the span rested. In addition to guidance by cable, the moving span was guided by the span of the first bridge just alongside, a skidway being bolted to the lower chord of the latter for this purpose.

On Sept. 18, 1913, the northerly span was launched, in 1½ hr. gross time or 22½ min. net moving time. The southerly span was launched Oct. 6, 1913, in 2 hr. gross time or 16 min. net time.

The same pair of supporting scows was employed for all four of the 408-ft. spans.

On Nov. 4, 1913, the second new bridge was put into service.

QUANTITIES—The old bridge had about 12,400 cu.yd. in piers and abutments. For the new bridge some 13,300 cu.yd. were added. The total weight of metalwork in the old bridge was about 4100 tons. In the new, the steel amounts to 14,231 tons, and there are about 3½ million rivets. The cost of the reconstruction was approximately $2,000,000.

George V., Inventor—King George of England has just sold a patent for a movable fireplace for $25,000, according to a wireless dispatch of Mar. 20. The fireplace is so constructed that when fixed in a partition wall it can be moved backward or forward, to make one fire serve for both rooms, and thus economize fuel. The purchaser is a contractor, who intends using the invention in the dwellings of workmen. In view of recent developments in British politics it may be a good thing that His Majesty has some trade to fall back on.

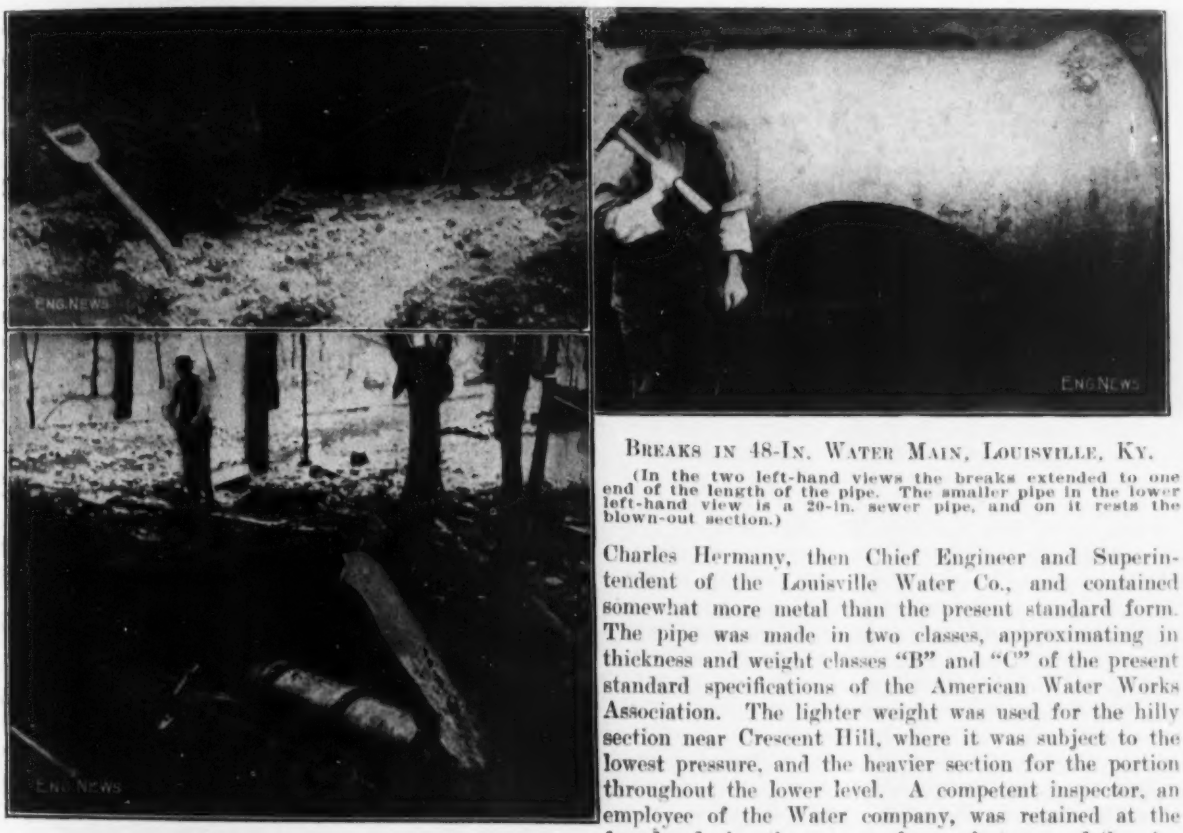
Breaks in a 48-in. Cast-Iron Water Supply Main, 1894 to 1914

By Theodore A. Leisen*

SYNOPSIS—In the 20 years that this force main has been in use there have been 47 breaks, chiefly in cold weather. Of the breaks 21 were circumferential cracks, 25 were either split longitudinally or else had pieces broken out and one was a split hub. The pressures have ranged from 10 to 85 lb., but most of the breaks appear to have been independent of pressure. The evidence points to temperature stresses as the chief course of the breaks: primarily latent internal stresses in the metal and secondarily cold weather stresses which cause the ultimate failure. The pipe in question was the first 48-in. pipe ever cast at the foundry at which it was made.

In 1891 to 1893, the Louisville Water Co., of Louisville, Ky., laid a 48-in. cast-iron water main from its Crescent Hill Reservoir to 12th and Oak streets, a total distance of 32,424 ft., as a main feeder to its distribution system. The route selected for the main was somewhat irregular both as to alignment and grade, necessitating a large number of bends approximating right angles. When originally laid, the pipe was subject to a pressure of about 10 to 15 lb. at its higher elevation and 40 to 45 lb. at the lower levels, but after the completion of the Crescent Hill Pumping Station the water-supply was repumped directly into the mains, and the pressure increased about 40 lb. over the former reservoir pressure, resulting in a maximum pressure of about 85 lb. at the lowest points. This increased pressure has existed since 1907. During the summer of 1907, when the repumpage of the water at the Crescent Hill Station was first started, the pressures were temporarily raised considerably above those mentioned, and this change accounts in part for a series of breaks in June and July of that year.

The 48-in. pipe was manufactured at the foundry of the Dennis Long Co., of Louisville, Ky. (afterward, and until quite recently, operated by the United States Cast Iron Pipe & Foundry Co.). The bell or socket end of the pipe was made from a special design (Fig. 1) by Charles Hermany, then Chief Engineer and Superintendent of the Louisville Water Co., and contained somewhat more metal than the present standard form. The pipe was made in two classes, approximating in thickness and weight classes "B" and "C" of the present standard specifications of the American Water Works Association. The lighter weight was used for the hilly section near Crescent Hill, where it was subject to the lowest pressure, and the heavier section for the portion throughout the lower level. A competent inspector, an employee of the Water company, was retained at the foundry during the process of manufacture, and the pipe carefully inspected, both in the methods of manufacture and after completion. Every piece, of both classes, was subjected to a hydrostatic pressure of 300 lb. per sq.in., and to the hammer test.



Breaks in 48-In. Water Main, Louisville, Ky.

(In the two left-hand views the breaks extended to one end of the length of the pipe. The smaller pipe in the lower left-hand view is a 20-in. sewer pipe, and on it rests the blown-out section.)

Both from the reports of the work, and from the result of repeated examinations made by the writer, there is abundant evidence to show that every possible precaution was taken to embed the pipe securely, and to thoroughly compact the earth all around it in the process of backfilling. The greater portion of the line was laid in hard

*Chief Engineer and Superintendent Louisville Water Co., Louisville, Ky.

clayey soil, and at no point where the pipe has been exposed has there been the slightest indication of unequal settling. The pipe has from 24 to 48 in. of cover, the more shallow portions probably being due to changes in street grades after the main was laid, or to erosion in sections of ungraded or unfinished streets. In every instance where an opportunity has been afforded for observation in recent years, it has been found that when the pipe is laid, a slight clearance—usually about ¼ in.—was left between the beaded end of the pipe and the base of the socket of the bell, indicating that an allowance had been made for expansion at all joints. As a resumé, therefore, it may be stated that there was nothing in connection with either the shop inspection or the supervision of the laying of this water main which could be the subject of adverse criticism.

The foregoing conditions have been detailed with some degree of minuteness in order that the results which followed may be more fully appreciated.

From January, 1894, immediately following the completion of the line, to January, 1914—just twenty years

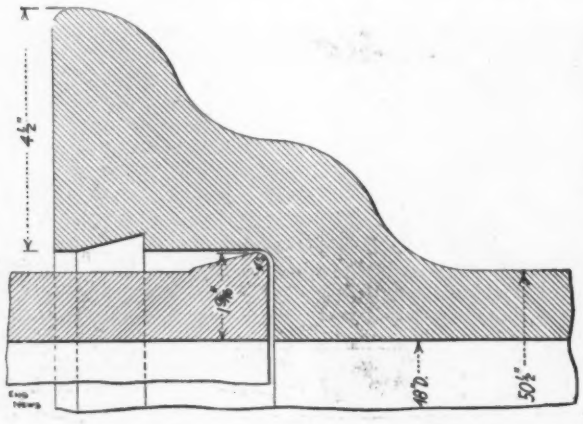


FIG. 1. SECTION OF BELL AND SPIGOT PIPE DESIGNED ABOUT 1891 BY CHARLES HERMANY FOR THE LOUISVILLE WATER CO.

—*there have been 47 breaks* in various parts of the main, the breaks occurring with a persistent regularity, year after year, and apparently with no indication of any cessation in the near future.

With a view to arriving at a satisfactory reason for these breaks, a careful analysis of the governing conditions has been attempted as far as the records will permit, and the results are submitted herewith.

Of the 47 breaks, 38 occurred in cold weather—between the latter part of October, and the early days of February—and but 9 in the months of May, June, July and September. The actual monthly distribution of the breaks was as follows:

Cold Weather Months: October, 2; November, 12; December, 13; January, 7; February, 4; total, 38. *Warm Weather Months*: May, 3; June, 2; July, 3; September, 1; total 9.

It may be noted that 31 of the breaks occurred in November, December and January, covering the period during which the water first reaches its minimum temperature, varying from year to year in accordance with climatic conditions, but always falling in one of these three months.

A classification of the breaks according to their general character shows that 21 were circumferential cracks that were repaired by covering with a split sleeve; 25 were either split longitudinally or pieces of more or less irregular form were broken out, and one was a split hub, the latter being of a nature which might have been due originally to excessive calking.

Of the 21 circumferentially cracked pipe, all but one occurred in cold weather—November to February—and of the 25 longitudinal cracks and broken-out sections, 16 occurred in cold weather—November to February—and 9 in warm weather—May to September.

Chronologically classified, it is found that for the thirteen years 1894 to 1906, inclusive, during which the reservoir furnished a maximum pressure of 45 lb., there were 25 breaks, an average of two each year, and for the seven years 1907 to 1913, inclusive, when the water was repumped directly through the mains at a maximum pressure (except during June and July, 1907) of 85 lb., there were 22 breaks, or an average of 3 each year. Of the 25 breaks recorded from 1894 to 1906, inclusive, 17 were under pressures of from 40 to 45 lb., and 8 under pressures of from 10 to 20 lb. Of the 22 breaks from 1907 to 1913, inclusive, 10 were subject to pressures of 80 to 85; 4 to pressures of 85 to 100 lb. (June and July, 1907) and 8 broke under pressures of about 40 lb.

The distribution of the breaks throughout the whole length of the main was more or less regular, regardless of elevation or pressure, and all were in straight pieces of pipe, no curve or other special having been affected.

Samples of the iron from the broken pipes were taken in several cases and submitted to both chemical and physical analyses. The following is a fair sample of the average result:

	Per cent.
Silicon	2.61
Sulphur	0.07
Phosphorus	1.01
Manganese	0.44
Combined carbon	0.17
Graphite carbon	3.00

Tensile strength, 20,000 lb. per sq.in.

Air valves have been placed at all points along the line where there was any probability of air accumulating, and these valves have been maintained in working order. For the past four years a recording pressure gage has been maintained on a separate service pipe directly connected to the 48-in. main, and no indication of water-hammer or other increase of pressure has been recorded at the time of the breaks, although several of the breaks were in the immediate vicinity of the gage.

The preceding statements cover practically all of the salient facts in the case, and are submitted as a basis for the discussion which follows:

Summarizing the conditions which may be accepted as controlling elements in causing many of the breaks, the factor which assumes paramount importance is the cold weather. In view of the large proportion of the breaks between Nov. 1 and Jan. 31, it is reasonable to assume that the contraction of the metal caused by the sudden reduction in temperature was the cause of the final strain that resulted in the fractures, and that in most of the winter ruptures pressure played little or no part, except as an accessory after the act.

This assumption is further justified by the fact that nearly half of all the breaks, and about 60% of the winter breaks, were circumferential cracks, extending from one quarter to one-half way around the pipe—a

type of fracture which no amount of water pressure could produce in a line of bell-and-spigot pipe with lead joints.

Of the larger breaks or blowouts, it is almost certain that four (June-July, 1907) were the result of a sudden increase in pressure, and it is known that three, and probably several others, were the results of older cracks which may have dated from the time of laying (caused during transportation or unloading). These taken in the aggregate would account for all of the warm weather breaks, thereby lending added strength to the hypothesis that contraction of the iron due to reduction in temperature was the culminating factor tending to produce the rupture in nearly all of the otherwise unaccounted for instances.

In order that this contraction could have resulted so disastrously, it is evident that certain latent internal stresses must have existed in the metal itself, to which, at the critical moment, were added the temperature stresses, combining to cause the final rupture of the molecular structure of the iron. That this theory fits the conditions governing the instances where circumferential cracks appeared seems indisputable. It may, with equal force, apply to the other breaks, under the assumption that the incipient fracture was of a similar nature, but that, because of its direction, the pressure of the water caused the crack to extend, either in an irregular circle until the two ends met, or in a direction toward one end of the pipe, thereby permitting the dislodgement of part of the shell of the pipe.

The pipe manufactured for the Louisville Water Co. was the first lot of 48-in. pipe ever cast at the Dennis Long Foundry. It is not unreasonable to suppose that (1) the time allowed for cooling before withdrawing the pipe from the flasks may have been gaged by experience with smaller-sized pipe, the result being that some of the pieces were withdrawn too soon, thereby being subjected to the possibility of uneven and too rapid cooling, particularly in isolated spots where no sand adhered to the hot shell, and that (2) the rapid cooling of such exposed parts would have resulted in the generation of internal stresses which, it is believed, were the primary and contributory cause of many of the fractures that have developed from time to time.

The acceptance of this theory as the logical one in the case under consideration, while affording no solution which will prevent further ruptures of the 48-in. main now in service, does suggest a method of prevention in future work through the medium of more careful inspection of the handling of the fresh pipe at the foundry, as an insurance against unequal cooling.

Superheated Steam in Locomotives was the subject of a paper recently read before the Institution of Civil Engineers (England) by Henry Fowler, of the Locomotive Department, of the Midland Ry. Mr. Fowler described several comparative tests conducted by the Midland Ry., to indicate the effects of superheat, as follows:

Two engines had been rebuilt exactly alike, except that one had been fitted with a superheater while the other used saturated steam and tests had been made with them between London and Derby (128 miles). The superheater engine showed a saving of 30% in coal and 34% in water over the other.

Recently it was decided to superheat the steam supplied to the high-pressure cylinder of one of the Midland's three-cylinder compound engines. Some doubt was felt as to the effect of the continued high temperature in the cylinder, but after three months' running no disadvantages had revealed themselves, and the engine had run perfectly satisfactorily. Tests against a sister engine using saturated steam showed a saving of 25.9% in coal and 22.3% in water. The average coal consumption on five double trips between London and Leeds was 0.0679 lb. per ton-mile for the superheater engine and 0.0916 lb. for the other; the corresponding figures for the water being 0.619 lb. and 0.797 lb. per ton-mile.

A Sanguine View of the Engineer's Opportunities†

By Frederic H. Fay*

The future of engineering is bright. Opportunities are expanding. The world is coming to expect and to demand a higher standard of the engineer and of engineering.

Engineering is the oldest of all professions, and dates from the earliest and most elementary civilization; but it is only within comparatively recent years that it has become recognized as a distinct profession, and we must still look to the future for that full recognition to which we engineers believe the profession is entitled.

In every field of activity the world is coming more and more to depend and rely upon engineers. But to meet these demands, engineers themselves must grow and become broader men. The successful engineer of today and of tomorrow cannot be like the engineer of yesterday, who too often would "retire into the technical recesses of his professional work and content himself with being the servant of other men." The engineer of today should be a broad-gage man, aggressive, alert, in touch with public questions outside his own narrow field, and a leader—not a follower—of men. It is upon the development of these qualities in engineers themselves that the whole future success of the profession depends.

The best technical school training for an engineer is one which gives a thorough grounding in the fundamental subjects of science and engineering without frills and specialties. In response to popular demand, there has been in most of our technical schools, during the past few years, a tendency to too high a degree of specialization. Fortunately, a reaction is setting in, and in the best technical schools today, courses are being rearranged so as to give the student a more thorough training in science and the general principles of engineering, with less specialization.

There is one quality of highest importance to the success of the young engineer, which cannot be taught in schools and which he must gain for himself, and that is the ability to properly meet and mingle with his fellowmen. In other words, he should be what is popularly known as a "mixer," and failure in this direction is responsible for the lack of, or limited, success of many an engineer who has the other requisites, and who but for this lack would undoubtedly achieve a far higher position.

The engineer should be a manager, and should give orders to others who can do the work under his direction as well as he himself could do it with the situation reversed. It should not be considered unprofessional for an engineer to be a capitalist, and, when he takes his proper place as promoter and organizer and shares in the profits of engineering enterprises, he will no longer be taunted with the saying that "an engineer is only good to spend other people's money." It is by acquiring individual strength that the engineer can give strength to the profession. It is well known that engineers of admitted proficiency often have to work under the direction of men who are unfitted by education and experience to direct engineering work. This is because the engineer is

*Division Engineer, Public Works Department, Boston, Mass.

†Extract from the Presidential address before the Boston Society of Civil Engineers at the annual meeting, Mar. 18.

a workman while the other party belongs to the class of "managers." The engineer has not reached his proper rank until he can hold the position of manager, as well as that of a designer and supervisor of work.

Engineers themselves are frequently responsible for the low estimate which the public places upon the value of engineering services. Chief engineers of corporations and public boards too often make the mistake of hiring engineering assistants at the lowest possible wage, under the false impression that by such rigid economy they are enhancing their own value in the minds of their employers. Many of us can name instances where young engineers of much ability and good training, but of somewhat limited experience, have been placed in charge of important pieces of work at salaries less than the lowest wage paid to skilled workmen employed by the contractors working under their direction.

Such practices do grave injury to the whole profession and cheapen it in the estimation of the public. Furthermore, they tend to react to the disadvantage even of the chief engineer, for his employers will reason that if the rank and file of engineers can be hired so cheaply, engineers as a whole are a cheap lot, and high salaries are not necessary in any grade, even that of the chief engineer himself. The chief engineer who pays a fair wage, taking account of the time and money which the young engineer has spent in securing his education and training (his working capital), will not only secure better, more loyal and more efficient service, but will help to raise the standard of the whole profession.

⁂

An 8000-hp. Boiler Plant to furnish superheated water for use in sulphur mining is being built by the Freeport Sulphur Co. (Texas), doubling the present boiler equipment of the Company for this purpose. Superheated water is forced into the sulphur formation to melt out the mineral, which is pumped to the surface.

The Indian-Built Bridge across the Bulkley River, British Columbia

Engineers who may have viewed askance the design of the 140-ft. bridge built by the Indians over the Bulkley River, in British Columbia, published in ENGINEERING NEWS, July 1, 1909, p. 19, will observe from the larger photograph recently taken, that the bridge is still open to traffic. It was built about 15 years ago. The structure is a cantilever-and-suspension combination and built mainly of round poles, telegraph-wire and wooden pins; few nails being used.

The telegraph wire used in the construction is said to have been obtained from a quantity left by Colonel Bulkley's party, builders of the telegraph line intended to connect Europe with America, by cable across Behring Strait, which project was abandoned in 1867 when the first transatlantic cable was laid. The bridge is suspended from a large steamboat cable obtained from the Hudson Bay Co. The travel across the bridge consists mainly of trappers and their outfits.

PRIMITIVE BRIDGE WITH CANTILEVER-AND-SUSPENSION COMBINATION

⁂

Garbage Reduction for Small Towns—In discussing garbage disposal before the Cleveland Engineering Society recently (see March, 1914, "Journal") C. O. Bartlett (president C. O. Bartlett & Snow Co., Cleveland) stated that he believed his company had nearly perfected an economic system of garbage reduction adaptable to small as well as to large towns. Although not ready to give details Mr. Bartlett outlined the process, as applicable to a town of say 5000, as follows:

Collect the garbage each day and place it in a steam-tight digester before it gets old and decays, and immediately cook or digest it. After digesting, steam press it down to about 50% moisture in the same digester, taking the water to a settling tank where the grease can be drawn off, saved, and the tank water passed to the sewer. Then dry the steam pressed tankage in the steam dryer down to about 12% moisture, which can be sold either direct to the farmers or to the manufacturers of commercial fertilizer. This is the simplest and best way that I know of. The principal object is to get the garbage into an absolutely tight receptacle and convert it into commercially valuable material.

Mitigation of Electrolysis in Underground Structures at Springfield, Ohio

In an article in ENGINEERING NEWS, Feb. 26, 1914, setting forth the general recommendations of the U. S. Bureau of Standards for the various methods of mitigating electrolysis of underground structures, it was briefly mentioned that study had been made of conditions in Springfield, Ohio, and certain recommendations had been made there for the use of the plan which the bureau favored—the insulated-negative-return system. It is now reported by a special joint committee that the proposed installation has been made and tests completed to ascertain the results. The following facts are taken from this committee's report to Chas. E. Ashburner, City Manager of Springfield, Ohio.*

The negative feeders were designed in accordance with the recommendations of the Bureau of Standards (see ENGINEERING NEWS, Feb. 26, 1914) to reduce the potential gradients of all parts of the track system to a mean value of 0.5 volt per 1000 ft. under average traffic, or 0.8 volt per 1000 ft. in rush hours. The amount of proper feeder cable in one case turned out to be 35% of the positive feeders of the company, and in the other case was 33%. In both cases, simple feeder lines with resistance taps between the feeders and the rails at proper points were used. The committee calls attention to the benefit of the peculiar local conditions where the power house of one railway company is on one side of the city and the power house of the other company is on the opposite side, so that by interconnection of the tracks at all crossings it has been possible to interchange current to a greater degree than before.

Tests† showed that the average of all the track-gradient values obtained was 0.23 volt per 1000 ft. The largest average for any one hour was 0.98 volt per 1000 ft. and in such cases troubles with track joints were noted which could be repaired. The average for all peak-load periods was found to be 0.35 volt, with 0.64 volt for the highest ten minutes.

In order to compare the results secured in Springfield with those where it was known that electrolysis had been made negligible, it was necessary to refer to regulated values in Great Britain and Germany. It was found, for instance, that in Great Britain the highest value for overall drop of the whole negative-return system was seven volts. The Springfield maximum value exceeded the British limit by only two volts, while only two readings exceeded it at all and the remaining 12 were well below. The limiting values for this overall drop in effect in Germany was reported to be 2.5 volts within city limits and for average traffic conditions, compared with which 20% of the Springfield figures were above and 80% below; the average was 1.6 volts, which is below. The German regulations for track gradients beyond city limits were reported to be equivalent to 0.3 volt per 1000 ft. Comparison with the Springfield situation showed that 15 points exceed the limit of the German rules, while 38 points are below. The highest values, however, were due to defective bonding, which are being reduced as the bonding is being repaired.

The committee believes that the condition of the pipes is now generally quite satisfactory. Where pipes are positive to track the potential difference between pipe and rail is less than one volt average during the hour of peak load, except at two points where the tracks are on private right-of-way and substantially insulated from the earth. In most cases the current flowing in both gas and water pipes was found to be negligible.

The committee does not recommend the design of the feeder-return system to protect lead sheaths of telephone and telegraph companies from electrolysis. They find that it would be cheaper to apply a limited amount of "drainage protection" (direct connection from the cable sheaths to the negative terminal of the railway power-supply system) and this they find permissible since there is no possibility of the difficulty arising from high-resistance joints encountered in various structures, as noted in the previous article already referred to. The committee advises care, however, to see that too much current is not drawn from the cables so that they may serve to increase the flow of current from surrounding structures, which involves danger of electrolytic action in these other structures.

Among the specific recommendations of the committee should be noted the following: (1) That the return-feeder system studied should be made permanent; (2) that the loads on interurban lines entering the city are not yet heavy enough to call for insulated negative feeders; (3) that all rail joints in the city be made equivalent in electrical resistance to no more than 8 ft. of rail; (4) that direct connections from pipe systems to railway return lines be not permitted.

*In the conduct of this investigation and the preparation of the report, the several parties were represented as follows: National Bureau of Standards, by Burton McCollum, G. H. Ahlborn and K. H. Logan, Washington, D. C.; City of Springfield, by E. O. Weaver, of Wittenberg College, Springfield, Ohio; Springfield Gas Co., by A. F. Ganz, Stevens Institute of Technology, Hoboken, N. J.; Logan Natural Gas & Fuel Co. and Ohio Fuel Supply Co., by S. S. Wyer, Columbus, Ohio; American Telephone & Telegraph Co., by H. S. Warren, New York City; Central Union Telephone Co., by E. S. True, Chicago, and W. G. Mullin, Columbus, Ohio; Springfield Ry. Co., by A. P. Way, Philadelphia; Springfield, Troy & Piqua Traction Co., by F. J. Green, Springfield, Ohio; Springfield & Washington Traction Co., by G. W. Baker, Washington Court House, Ohio; Springfield & Xenia Telephone Co., Deloss Odell, Springfield, Ohio.

†The measurements of overall voltage for the feeder line and most of the measurements of potential gradients along track were made by wires supplied by the telephone company, running from the central exchange building to selected points throughout the railway net work.

Requiring a Fee from Bidders for the Use of Engineers' Plans

In our issue of Oct. 23 last, we discussed the resolution adopted by the General Contractors Association opposing the charging to bidders on a contract of a fee for the use of plans for the work.

This matter has been under consideration for some time of a committee of the American Institute of Consulting Engineers. At the annual meeting of the Institute, on Jan. 20, this committee presented a report as follows:

FIRST—In respect to charging a fee for the use of plans, it is our opinion that, when contractors are invited to bid upon any work, the necessary plans should be furnished to them by the engineer without charge. If, however, the work is to be publicly let, there should be some limitations made with regard to the number of plans to be furnished free by the engineer. We believe that in such case the public or advertised invitation for bids should provide that the plans be on view at one or more places where all bidders can conveniently call and examine them. If prospective bidders ask for the use of plans under this last condition, we believe that the engineer should require a deposit for them, which

deposit may be in an amount sufficient to insure the return of the plans, and that when such plans are returned to the engineer, after the award is made, the engineer should return the amount of the deposit.

SECOND—We are of the opinion that a sufficient number of plans for the execution of a contract should be furnished the contractor without charge. As to the number of sets of such plans, we are unable to make any definite recommendation other than that we believe the engineer should furnish sufficient for all reasonable construction purposes, and for any number of excess thereof he should charge the cost of reproduction.

THIRD—We believe that the engineer employed by a private client should lend his influence against the requirement of a deposit of a certified check by a contractor bidding upon his work.

FOURTH—We are of the further opinion that it would be advisable in the interest of all concerned that the subject matter of the General Contractors' resolution be discussed by a joint committee composed of equal representation from:

a. American Institute of Consulting Engineers, Inc.
b. American Institute of Architects.
c. General Contractors' Association.

We therefore recommend that the Secretary of the American Institute of Consulting Engineers, Inc., be directed to invite the other two associations in interest to join them in the appointment of a committee which may take up this subject.

Committee on Relations between Consulting Engineer, Contractor and Client.
by
W. J. WILGUS, Chairman.
Committee on Professional Practice and Ethics.
by
F. A. MOLITOR, Chairman.

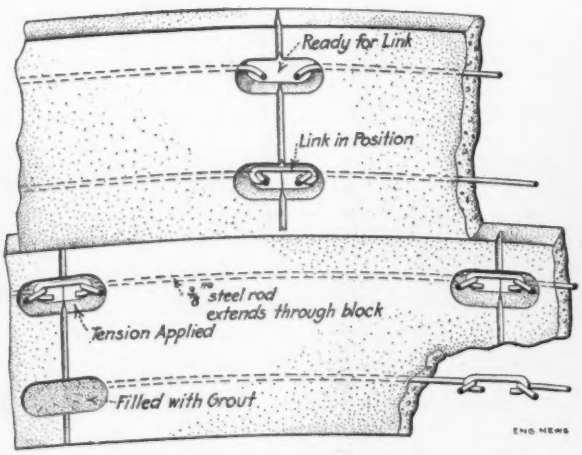


FIG. 1. VIEW OF HURST CONCRETE BLOCKS IN PLACE, IN TANK

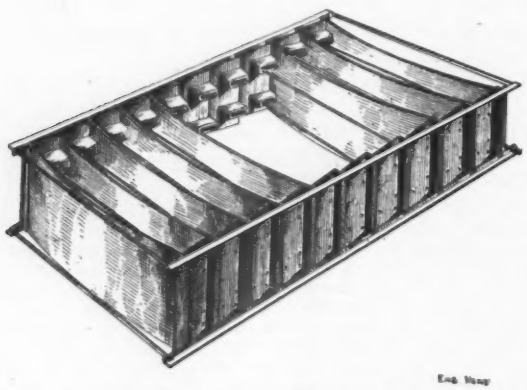


FIG. 3. FORM USED IN MOLDING BLOCKS

A Reinforced-Concrete Block Construction for Tanks

The accompanying halftone and cuts illustrate a reinforced-concrete block construction which was originally designed to be used for silos, but which has been applied several times to water tanks of low head. The essential feature of the construction is the molding of separate concrete blocks, each provided with a row or rows of horizontal reinforcing, which reinforcement is tied together by a special clip so as to form a continuous circumferential reinforcement when the blocks are laid up in the circular wall of the tank.

Fig. 1 represents in perspective the design of the individual block. They are reinforced, as shown, by short rods protruding from recesses cut in the ends of the blocks. When the blocks are set up in the wall in the position shown, the opposite rods from the adjoining blocks are tied with an open link, which slips over the two protruding ends and the ends are then bent down so as to form a tight connection of the reinforcing rods. This is shown in the upper left-hand opening of the lower block in Fig. 1. The opening is then filled tight with grout or very wet mortar, and the inside of the tank is then plastered with a cement-plaster finish.

Fig. 2 shows the interior of a tank built with these blocks. This tank is in Columbia, Tenn., and is 10 ft. high, has a diameter of 43½ ft., and a capacity of 110,000 gal. The blocks used here are 6x12x24 in., and

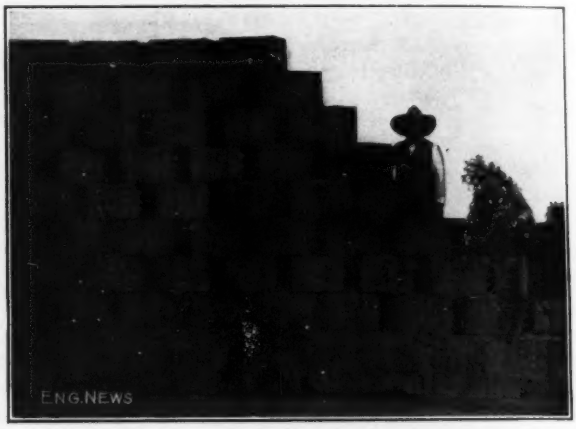


FIG. 2. A 10-FT. WATER TANK BUILT OF CONCRETE BLOCKS

are reinforced with four lines (instead of two as shown in the design in Fig. 1) of ⅝-in. rods. The view shows at the upper part of the tank the openings with the rods joined and below the opening filled with concrete mortar.

Fig. 3 shows a perspective view of the forms in which the blocks are cast. These forms are either kept on the job and the blocks cast there, or may be in a shop and the blocks made in great numbers to be used in various places. It will be noted that the shapes of the forms are such that a comparatively wet mix will have to be used and the only pressure which can be applied is hand ramming.

The block is controlled by the Hurst Silo Co., Chicago, Ill., which company sells the molds shown in Fig. 3 together with the right to use the block, which is patented.

Railway Shelter Stations of Unit Concrete Construction

A type of structure in extensive use on electric interurban railways is the shelter or small waiting room provided at the smaller stopping places. For buildings of this class the Pacific Electric Ry., which has a system of nearly 1000 miles in the district around Los Angeles, Calif., has adopted the unit system of concrete construction, in which the buildings are composed of separate concrete members or units. The design combines permanent and economical construction with attractive appearance and low maintenance cost. It was also found to be cheaper than either brick or monolithic concrete construction, under the local conditions, while the cost is said to be only about 15% greater than for wood construction. About 100 to 200 of these stations are to be built.

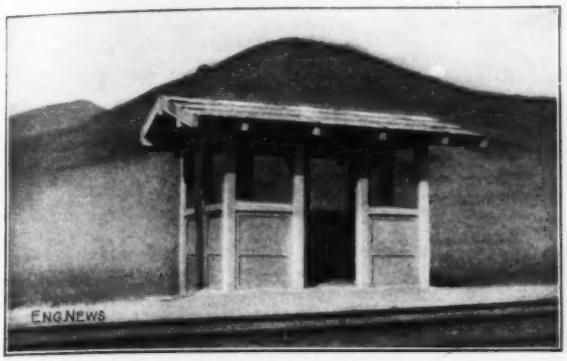


FIG. 1. SHELTER STATION OF UNIT CONCRETE CONSTRUCTION; PACIFIC ELECTRIC RY.
(Door and windows not placed.)

The unit system of reinforced-concrete construction was described in ENGINEERING NEWS, June 15, 1911, and has been used for several large electric railway structures, including car houses at Philadelphia and Harrisburg, Penn.

For this system of reinforced-concrete construction, it is claimed that the internal stresses due to shrinkage are reduced to a minimum, and the liability of damage due to temperature changes almost eliminated by the use of properly located expansion joints. Greater elasticity is secured also by the joints or breaks in the continuity of the concrete being placed at predetermined and logical places. The possibility of failure by removing the forms or supports too soon or from other causes is eliminated, and any defective unit may be detected by inspection and rejected before being placed in the building. It is further claimed that on account of the high quality of the concrete, lighter sections may be used in this manner than with monolithic concrete.

The design and construction of the stations is shown in Figs. 1 and 2. The building is 12 ft. by 8 ft. 3 in. outside, with a clear height of 8 ft. 6 in. There is a doorway in the side facing the railway, and each of the other panels has a window opening 28x44 in. A concrete bench extends around three sides of the interior. There are four posts on each side, carrying a longitudinal wall plate and supporting the ends of cross beams, each beam having a vertical stub to support the ridge beam. Upon the ridge beam and the wall plates rest the rafters, which carry the concrete roof slabs. In each end is an additional post, extending up to the window sill only. The walls are formed of panels and rails fitted to grooves in the posts. The posts stand on concrete footings, and a concrete floor is laid.

Each building contains 119 unit members, the heaviest of which (the columns) weigh 400 lb., while the lightest weigh about 35 lb. Thus all members can be handled by three or four men and no extensive equipment is required for erection. The building contains 4.85 cu.yd. of concrete, exclusive of the column footings. Owing to variation of grades, the footings were cast in place, but the quantity of concrete is very small and can be quickly mixed and placed by hand. Each footing is 21x21 in., 13 in. deep, with the top 5 in. below the floor level and having a socket 10 in. deep for the post. All the units were cast at a central casting yard by a force of from three to four men, and after being removed from the forms they were allowed to season. They were then loaded on a car and transported to the site, and unloaded ready for the erecting gang.

The tops of the wall slabs which form the exterior of the station were troweled to a smooth straight surface and brushed to take the glaze off the surface caused by the use of the trowel. The interior, which is the lower side of the slab, is left as it comes off the form, and as the forms are smooth they give a good surface finish. The columns, girders, lintels, etc., have one side troweled and brushed, the other three sides being left as they came from the forms, which are so constructed that no seams show in the concrete. The reinforcement consists of wire mesh and small deformed bars.

The roof slabs are 30x26 in., weighing 190 lb. each. They were cast with a 1½-in. overlap; which with the red coloring used in the finish, gives the appearance of a tile roof. No waterproofing was used in the concrete, simply a rich mix well worked and hard troweled to a smooth finish, which gives a water-tight roof with no other covering. These slabs were reinforced with wire mesh.

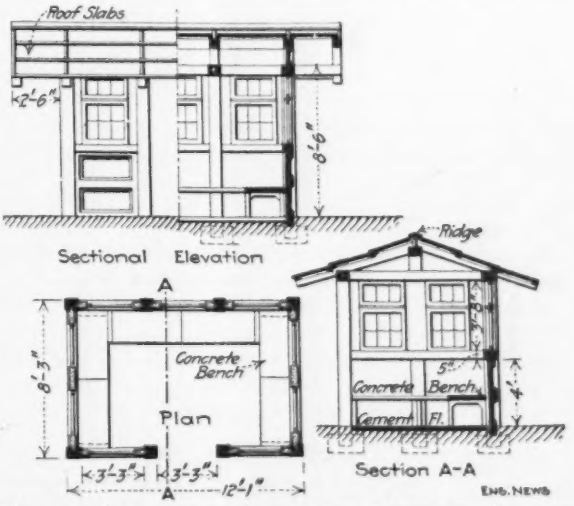


FIG. 2. CONSTRUCTION OF UNIT CONCRETE SHELTER STATIONS; PACIFIC ELECTRIC RY.

In erecting these stations, the columns are set in sockets in the monolithic footings and grouted in place. The wall slabs and sills which fit in slots in the columns, are

then slid into place and grouted. The lintels are then set and grouted, followed by the girders and finally the roof slabs, all being carefully grouted with rich concrete. The units are held by projecting bars of the steel reinforcement or by dowels which, on being grouted, give rigid connections at the joints. The benches are then placed and the floor laid. The units are all marked before being removed from the forms to conform to the marking on the erecting plan. One of these buildings may be completed in from four to six days under ordinary conditions.

No arrangements are made for heating these stations as the climate of California makes this unnecessary, but it could be done very simply by installing electric heaters under the benches.

The buildings were designed by the Van Sant-Houghton Co., of San Francisco, Calif., the Western representative of the Unit Construction Co., of St. Louis, Mo.

Hypochlorite Water Disinfection and Typhoid Fever in Eight Cities

Probably no improvement in public water-supplies and certainly none in water purification has swept over the country so rapidly and been such a boon to water-works engineers and superintendents and water consumers as water disinfection by hypochlorite treatment. In a paper entitled "Hypochlorite Treatment Firmly Established," read in February before the Indiana Sanitary and Water Supply Association, by C. A. Jennings, consulting engineer, Union Stock Yards, Chicago, the author expressed the belief that since the introduction of the process at the Bubbly Creek filter plant (Stock Yards) in 1908 at least 600 cities have adopted hypochlorite treatment. Where the adoption of the process was based on proper investigation and its use has been governed by intelligence, good results have followed.

The use of hypochlorite in water treatment should be confined practically to the elimination of disease germs of intestinal origin. "The efficiency of the treatment," Mr. Jennings states, "will vary inversely as the turbidity of the water." The process is now being used "with rapid sand filters, slow sand filters, coagulation and sedimentation, impounding reservoirs and on well water alone."

Mr. Jennings presented typhoid charts for eight cities having various kinds of water-supplies, the statistics covering a maximum period of 11 years before and 5 years after beginning the use of hypochlorite. The gist of the information conveyed by the diagrams was also given in text form, as follows:

BALTIMORE, MD.—For the 11 years previous to the use of hypochlorite, Baltimore had a typhoid fever death rate of 35.2. Eliminating the year 1911, during the last six months of which hypochlorite was used, the death rate was reduced to an average of 22.8 for the years 1912 and 1913, while using hypochlorite, a reduction of 35%. Baltimore uses chemical coagulation and sedimentation and hypochlorite. A rapid sand filter plant is being installed at this time.

CLEVELAND, OHIO—The average typhoid death rate in Cleveland for the 11 years previous to the introduction of hypochlorite in September, 1911, was 35.5. The average for 1912 and 1913, while using hypochlorite, was 10, a reduction of 72%. Cleveland uses no other treatment than disinfection at this time.

DES MOINES, IA.—The water-supply is collected in filter galleries under the old bed of the river. Hypochlorite treatment was begun in December, 1910, during a typhoid epidemic. The average typhoid death rate for the years 1905-1910, inclusive, was 22.7, and for the three years while using this process, it was 13.4 per 100,000, a reduction of 41%.

ERIE, PENN.—During the winter of 1910-11, [illegible] experienced a typhoid epidemic of a very severe form. The death rate from this disease was 197 per 100,000 for the year 1911. Hypochlorite treatment was begun in March, 1911. The average typhoid death rate for the 11 years, 1900-1910, inclusive, was 38.4, and for 1912 and 1913, while treating the water-supply, it averaged 13.5, a reduction of 65%.

EVANSTON, ILL., is another city on the Great Lakes that suffered a typhoid-fever epidemic in 1911, but it was prevented from assuming large proportions by the introduction of hypochlorite in December, 1911. The city had an average typhoid death rate of 26 per 100,000 for the years 1907-1911, inclusive. The rate dropped to 14.5 as the average for 1912 and 1913, a reduction of 44%.

JERSEY CITY, N. J., was the first city to adopt hypochlorite treatment for a municipal water-supply, which was in September, 1908. The water is stored in an impounding reservoir, and then treated with hypochlorite. The average typhoid death rate for the years 1900-1907, inclusive, was 18.7 per 100,000. The average death rate since the introduction of hypochlorite, for the years 1909-1913, inclusive, has been 9.34, a reduction of 50%.

KANSAS CITY had a typhoid death rate of 43 per 100,000 during 1910. Hypochlorite treatment was begun in January, 1911. The average typhoid death rate for the years 1900-1910, inclusive, was 42.5 per 100,000. During 1911, 1912 and 1913 the average was only 20. This was a reduction of 53% over the former rate.

OMAHA, NEB.—The water-supply of Omaha has been coagulated and settled in basins and then treated with hypochlorite since May, 1910, when disinfection was installed because of the large amount of typhoid fever in the city at that time. The typhoid death rate in 1910 was 89 per 100,000. The average typhoid fever death rate for 1900-1909, inclusive, was 22.5. For the years 1911, 1912 and 1913, the death rate averaged 11.8, a reduction of 47%.

The population of the eight cities totals about 2,033,000. The average typhoid death rate for all the cities was 30.2 per 100,000 before and 14.4 after the use of hypochlorite, a reduction of 15.8 deaths per 100,000 or 51%.

Of the eight cities considered, six had higher typhoid rates in 1913 than in 1912, but Mr. Jennings remarks that 1913 has been called a "typhoid year" and that doubtless the number of typhoid deaths would have been much larger that year had it not been for the use of hypochlorite.

The Use of Co-ordinates in Surveying and Laying Out Tracts for Irrigation

By Hal H. Logan*

The following method of preparing lands for irrigation does not embrace any new principles or operations. However, it was used to advantage on the property of the Carlsbad Plantation & Orchards Co., about 12 miles southeast of Carlsbad, N. M., on the Pecos River, and probably the same method would be effective elsewhere, when used under similar conditions.

A portion of the lands had very little grade; the topography was flat and twisted. The "border" system was already in use on the project for applying water to the land.

Under the border system of irrigation, which has long been in vogue in the southwestern part of the United States, the land is divided approximately into rectangles by small levees, or borders, only a few inches high. The lands lying between them have a slope in the direction of their greatest dimension, but should be level transversely so that when water is admitted to the upper end it will

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spread evenly between the borders and flow uniformly to the lower end. For any particular soil and slope there is an economical spacing and length for borders. This can be determined only by experience.

On the project under discussion the soil was exceedingly light and friable and was easily washed, so that, no doubt, the border system was the one best adapted, although the initial cost of leveling and preparing the land for distributing water was greater than it would have been under other systems.

Following is a brief description of the work of surveying and laying out the irrigating system on a small portion of the property.

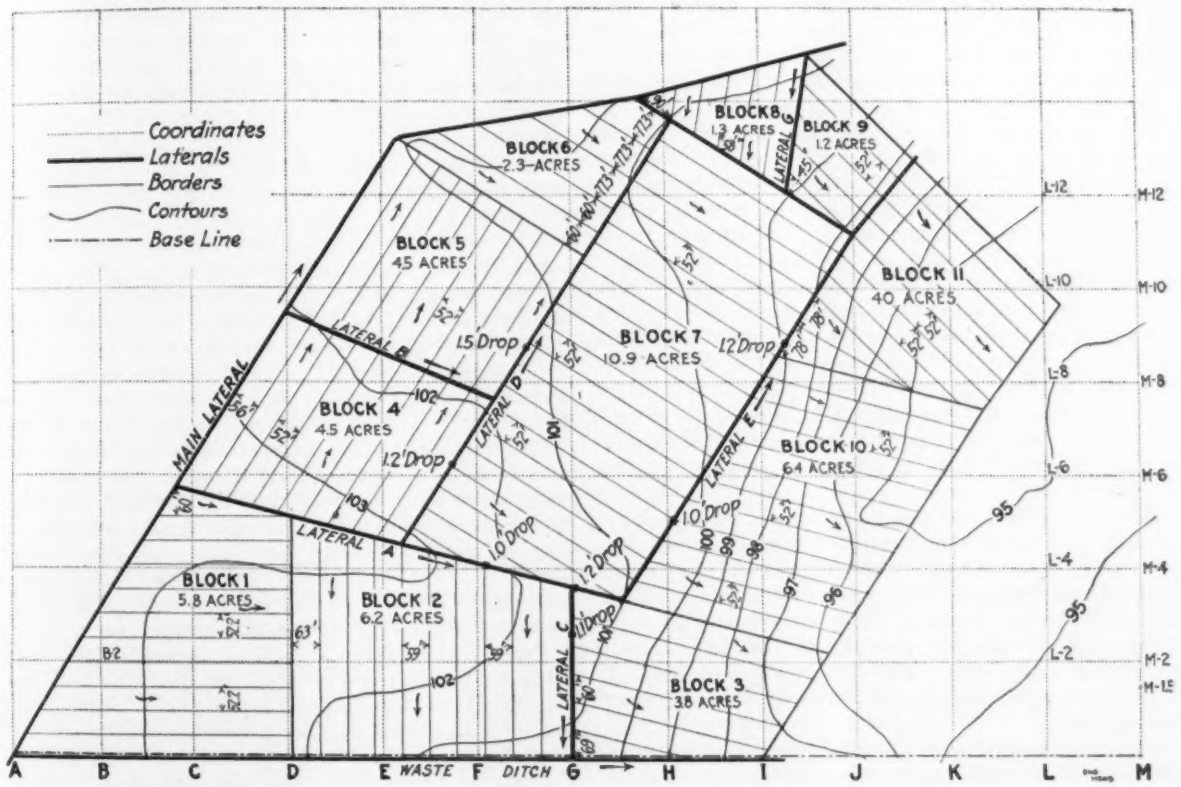
TAKING TOPOGRAPHY—Accurate topography was a necessary prerequisite to the laying out of the distribution system. The topography party consisted of an instrumentman, head chainman, who also acted as rodman, rear chainman and stakeman. A transit was used for determining both alignment and levels throughout the work.

Referring to the accompanying plan, the first field operation was the staking out of the base line *AM*, with stations 200 ft. apart. The elevation of each station was ascertained both on the ground and on the tops of well driven stakes. The latter readings were used as bench elevations in future work.

Next, the transit was set over the point *M* and its H.I. measured from the top of the stake. Then an angle of 90° was turned from the base line *AM*, and the instrument clamped. Using a 200-ft. tape, a point *M*-2,200 ft. distant from *M*, at right angles to the base line, was determined and its elevation secured by a rod reading. Next, *M*-4, 200 ft. from *M*-2, was established and its elevation recorded. Similarly, the elevations of points *M*-6 to *M*-12 were obtained.

All stations measured from the point *M* on the base line and at right angles thereto were defined in the field-book by the prefix *M*. The number used in conjunction denoted the distance out in even 100-ft. lengths. *M*-1.5, for instance, indicated a point 150 ft. from *M*. Stations closer than 200 ft. were not ordinarily established. They were used only when a change in slope could be detected with the naked eye.

When it was deemed desirable to obtain the elevation of points not on the line on which the instrument was clamped, such points were located by pacing, or by measuring at right angles from known points on line. Ordinarily, no stakes were left in the ground except where they seemed likely to be needed for future reference.



IRRIGATION TRACT SURVEYED AND PLOTTED BY THE USE OF RECTANGULAR COÖRDINATES

After work on the "*M* line" was completed, the instrument was moved to *L*, clamped on a line perpendicular to the base line, and a new H. I. obtained. At the point *M*-12, a right angle was laid off with the tape, and at a distance of 200 ft. the point *L*-12 established. This checked the "*L* line" determined by the transit. From the point *L*-12, 200-ft. stations were set, working toward the transit. It was found that the distance back to the instrument checked very closely, and by so working, the tramp back was made as productive as the one away from the base line.

Work was carried on in a similar manner from all stations on the base line. As indicated in the plan, the

reference line for all fieldwork was taken on the west side of the tract. It could have been placed in the middle and the work carried on from both sides.

PLOTTING TOPOGRAPHY—The principal advantage of taking field notes in the foregoing manner lies in the form of the data and their adaptability to plotting. Such notes can be easily and quickly plotted without the aid of a protractor, scale or straight-edge and without any office reductions. All information was referred to a system of rectangular coördinates and consequently was readily reduced to map form by the coördinate method.

For the Carlsbad work a piece of cross-section paper, ten lines to the inch, was the groundwork for the plotting. Assuming a scale of 100 ft. = 1 in., the distance between the fine lines represented 10 ft. and between the heavier lines, 100 ft. The base line was made to coincide with one of the heavy lines and the points *A* to *M* placed thereon. Elevations of all other points taken in the course of the fieldwork were placed directly at their proper location on the cross-section paper. Shots could be plotted in the field if considered advisable.

In the accompanying plan only the large squares, with sides equal to 200 ft. on the cross-section paper, are shown by the dotted lines. For the sake of clearness, elevations have been left off the drawing; but contours are shown, which were plotted from the elevations. On the original map, in addition to the 1-ft. contours, those representing variations in elevation of 6 in. were drawn where the ground was flat and the 6-in. contours would be 100 ft. or more apart. These 6-in. contours have also been omitted from the accompanying plan.

LOCATION OF DISTRIBUTION SYSTEM—With the topographic map before them, the engineers of the project were able to plan lateral and border systems with a view of securing the maximum economy in leveling the ground surface and in building borders, in labor and time consumed in distributing water and in the quantity of water used.

The plan shows the manner in which the irrigation system was fitted to the ground. The main lateral supplied all of the sub-laterals which in turn delivered water to the border systems. Efficiency in operation demanded that there be few changes in the direction of borders. Economy in leveling the ground required that the system fit the topography. The plan of using "blocks" of borders was a compromise between these two divergent requirements.

The system was projected upon the original topographic map. The lines on the cross-section paper became coördinates for locations thus projected. In a manner similar to that used in the taking of topographic notes points were laid out on the ground. For example, "Lateral *A*" intersects the "*C* line" at *C*-5.65, and the "*G* line" at *G*-3.60. These two points determine the position and direction of the lateral. Its length could be either scaled or computed from the coördinates.

In locating the distribution system, the laterals were first staked out and then a stake was placed at each end of each border. On account of the light soil very little grade could be used in laterals. Small drops were installed to keep the alignment of the laterals straight.

CONSTRUCTION—Laterals were constructed with a "20th Century Grader." Borders were made by casting up a double furrow with a plow. The ground between borders was leveled transversely with "Fresno" scrapers and afterwards dragged. For the leveling work stakes marked with the necessary cut or fill were set at intervals varying from 20 to 50 ft. Very little leveling was required.

Mississippi River Bridge Projected at New Orleans

The project for a bridge over the Mississippi near New Orleans, first agitated in 1888, and subsequently carried to the point where a number of complete sets of plans were developed, has been revived sufficiently to promise early beginning of the undertaking. E. L. Corthell, North Egremont, Mass., is consulting engineer for the project.

The bridge project of the early nineties was fully dealt with in our issue of Apr. 1, 1897, p. 208, where the bridge was illustrated by perspective. A number of earlier notes in ENGINEERING NEWS, from 1888 to 1893, may also be referred to. The Southern Bridge and Railway Co., a corporation backed by the Southern Pacific Co., held the charter; Mr. Corthell was president and chief engineer. The crossing was to be made in the neighborhood of Twelve Mile Point, 4 or 5 mi. above New Orleans, at a point where, according to river experience, there had been no change in bed or banks within the memory of man. The span of the cantilever bridge was to be 1070 ft. between centers of main piers, and the clearance 85 ft. above extreme high water, and the width between trusses 40 ft. The structure resembled greatly the more recent Ohio River cantilever bridges, as Wabash and Beaver. The suspended span was to be 440 ft. long, the anchor arms 660 ft. 8 in. each. The design approved and accepted at that time was the work of the Phœnix Bridge Co., who had submitted designs in competition with a number of other concerns. The foundations were to extend to a depth of 170 ft. below low water, the water depth being about 100 ft. The material at foundation depth was determined by wash borings extending to over 200-ft. depth, which penetrated only sand, rather coarse, at 170 ft. and below. Rock was not found within attainable distance. It was intended to sink the piers by open dredging through wells (cylinder piers).

Present ideas favor a double-deck bridge, one deck being for highway and electric railway traffic, while the old project was for a railway bridge only. Designs have not yet been worked out, nor a location actually selected. The charter of the old Southern Bridge and Railway Co. expired over a dozen years ago, and no doubt fresh proceedings will have to be gone through to get Congressional approval. However, Mr. Corthell states that the site then chosen is so favorable that it may be regarded as the only available site, and according to his prophesy the bridge now contemplated will have the same location.

While a long-span cantilever bridge is the probable and logical thing for the location, designs were also made in the time of the old Southern Bridge and Railway Co. for low-level crossings with movable spans, for a vertical lift bridge and for a double-draw swing bridge, each of these two designs giving a clear opening between main piers of 1000 ft. as required by the War Department. While these plans (particularly that for the two-span single bridge) were worked out in complete detail at the time, we mention them now only as a historical reminiscence.

Editorials

Last week occurred the first anniversary of the great Central States floods of 1913. The people of Ohio and Indiana will remember for many years the rains and devastating torrents of the week from Mar. 23 to 30. No such widespread property destruction by natural agency has ever occurred in the United States.

Similar floods are not likely to occur soon—within half a century or so—or perhaps within two or three centuries. But the best we can say is "not likely," the *possibility*, though remote, of a recurrence cannot be denied. Even more disastrous floods *may* occur.

Indications are that a wet cycle of years is on, or is coming on. The general course of the rainfall curve suggests this. The rains of March, 1913, may then be not an isolated phenomenon but merely a striking feature of a high-precipitation epoch. The rainfall-floods of recent months in Texas and California—themselves only second in interest to the Central States flood—point in the same direction.

The year has been a busy one, for citizens, railway companies, county and city authorities; so busy that there was neither time nor means for going farther and building stronger flood bulwarks. A repetition of the 1913 floods at the present time would find the devastated regions just as unprepared and vulnerable as last year—and the people of those regions know this. However, plans have been considered and new administrative measures have been framed for carrying out future effective protection work. There is every prospect that the coming season will show much achievement.

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Specifications for Timber for Use in Factory Construction

A half-dozen years ago it looked as if the use of timber in mill construction was likely soon to disappear. The rapid development of concrete and steel construction and the rapid advance in the price of first-class timber promised to bring about a sweeping change in practice and to bring to an end the standard "slow-burning" mill construction which has been so long and so successfully used in the East, especially in New England.

The enormous development of the lumber industry in the South, however, has more than kept pace with the demand for lumber during the past three or four years with the result that at the present time prices on Southern pine timber rule lower than they have for many years. There are numerous practical advantages in timber mill construction which strongly incline many mill owners to its use; and the problem before engineers engaged in erecting structures of this sort is how to purchase timber that will give results equal to those which were obtained by the Southern pine available a quarter of a century ago.

Within the last month, a report has been made to the Associated Factory Mutual Fire Insurance companies of New England by F. J. Hoxie, giving the results of a tour of inspection of the Southern pine districts from which timber for the Northern market is procured. The matter in the report is of interest to every engineer who has to draw specifications for or inspect Southern pine timber.

The two chief things which are aimed at by the engineer in purchasing Southern pine timber are to obtain the true long-leaf pine instead of short-leaf or loblolly pine, and to obtain material sound enough to be free from the danger of dry rot. There is a more or less prevalent idea that by securing timber from certain designated localities the purchaser can be sure that he is getting only long-leaf pine. Mr. Hoxie states, however, that he found in all cases short-leaf pine growing in the same forest with long-leaf and being cut by the same mills. Where long-leaf pine is removed from a tract, short-leaf pine and loblolly take its place as second growth. In the forests visited in Central Alabama by Mr. Hoxie, long-leaf pine of excellent quality covered the hill tops, while the valleys and ravines were occupied by equally large trees of loblolly and short-leaf pine. There are large sawmills owning great tracts of forest lands from which they are cutting excellent long-leaf pine and all around their lands are small semi-portable sawmills buying logs or stumpage from the farmers, most of which is short-leaf pine of very poor quality.

Not only is the place of origin, therefore, not a proof that the purchaser is obtaining long-leaf pine, but the timber itself cannot certainly be identified by inspection. While reputable lumbermen attempt to keep the long-leaf pine separate, to fill specifications calling for this variety only, the lower grades of merchantable timber called "square edge and sound" includes all varieties—the inferior long-leaf trees, short-leaf, Cuban and loblolly. When the other varieties of pine become mixed with long-leaf pine the difference cannot be told by surface inspection and not always certainly even by microscopic examination. The same tree varies enormously in the fineness of grain between the top and bottom. In many cases, long-leaf pine shows a coarser grain than short-leaf.

One of the chief reasons why long-leaf pine is preferred by the engineer is not only its greater strength, but its greater resistance to dry rot. Mr. Hoxie found dry rot and fungus growing about several of the Southern lumber yards, indicating the danger that timber may be infected with the dry rot disease before it is shipped from the mill. In one specific case, eight beams were purchased and carefully inspected to secure prime quality hard pine, the beams being intended for use in a mill which had become infected with dry rot. Only three of these eight beams, says Mr. Hoxie, had sufficient natural resistance to withstand fungus growth; three of the specimens were probably short-leaf pine, and one was infected with living fungus when received.

Mr. Hoxie makes the proposal that some of the large lumber manufacturers owning large tracts of long-leaf

pine containing at least 100,000,000 ft. of standing timber and capable of furnishing 12x16-in. merchantable timber should have their names listed by the Factory Mutual Insurance companies in the same way that tanks, sprinklers, pumps and other appliances are at the present time.

Possibly the final recommendation made by Mr. Hoxie is the most important of all. It is as follows:

> Studies should also be made on antiseptic treatments to determine those which are most desirable for use on mill timber, in order to make the less durable varieties of lumber safe for mill construction.

Since it is admittedly so difficult to identify true longleaf pine timber, that there is always some risk that the poorer varieties may be included in a shipment, a process of antiseptic treatment which would make any sound timber reasonably proof against dry rot would have great value. For mill construction, the fire risk would rule out some of the most used timber preservative processes. On the other hand, since the timbers inside a mill are protected from the weather, the range of possible antiseptic treatment is much widened. Treatment by brushing or dipping would probably give sufficient penetration without going to the heavy expense of pressure-tank treatment. It is to be hoped that the Factory Mutual laboratories may undertake the investigation.

Brick Paving for New York State Roads

Governor Martin Glynn, of New York, is not an engineer, nor does he claim to be an expert on highway construction, but the special message on New York State highway work which he sent to the legislature last week is well worth careful reading by all engineers interested in highway construction; and it is likely to be quoted from for a long time to come. Because of the Governor's position, if for no other reason, his message is likely to have a large influence in determining the future highway policy of New York State. By reason of New York's enormous expenditures on highway work, it is likely to influence practice in other States as well, particularly in the East.

We print the Governor's message practically in full on another page of this issue. Its salient feature is the declaration that the heavy cost of maintenance of macadam roadways under heavy traffic in New York State is placing the State under a financial burden too grievous to be borne. The Governor declares that New York State highways paved with macadam, which cost in the neighborhood of $12,000 per mile to build, cost $1000 per mile per annum to maintain, in addition to which, the macadam surface must be entirely renewed at ten-year intervals at a cost of $6000 per mile.

These figures will doubtless be challenged by those interested in bituminous macadam roads. They will point to examples of bituminous macadam which have in some cases been subjected to heavy traffic for a number of years, with only trifling expense for maintenance. Unfortunately for the defenders of macadam paving, however, very little of the bituminous macadam pavement laid on New York State roads during the last half-dozen years has given any such good account of itself.

There may have been good reason for these failures in the character of the materials used or the manner in which the work was done. These excuses, however, are not likely to save the day for bituminous macadam. Numerous investigations of New York State road work have made it sufficiently clear to the public that the newly built bituminous macadam roads, constructed at heavy cost, have gone to pieces very badly in a large majority of cases, and that the State has been obliged to expend millions of dollars for their maintenance.

Here, again, it is doubtless true, as is indicated in the recent report made by Commissioner Osborne concerning his investigation of the State road repairing contracts, that a large amount of money has been wasted and stolen, in carrying on this repair work. Making all allowances for this, however, it is clear that even if the repair work had been done economically and efficiently under the best possible system, the total maintenance expense per mile would still have been very large.

Governor Glynn's declaration that a country roadway costing a thousand dolllars or more a mile per annum for maintenance is a costly luxury, cannot possibly be disproved. A thousand dollars per annum is the interest at 4% on an investment of $25,000. If a type of road could be found so permanent that it would require only $100 per year for maintenance instead of $1000, the saving in the annual repair bill would pay the interest on an investment $22,500 greater. In other words, since the State can under ordinary conditions borrow money at 4%, it could afford to pay over $20,000 a mile more for a permanent roadway than the $12,000 or so per mile that it is now paying for bituminous macadam roads. The advocates of bituminous macadam who attack this position of the Governor will have to show that bituminous macadam roads can be built and have been built which will withstand heavy motor traffic for a considerable term of years and not require such heavy annual expenditures for maintenance.

Turning now to the permanent roadways which the Governor purposes to substitute for macadam, these are of two classes: concrete and brick. Concrete, however, he dismisses on the ground that the experience hitherto obtained with it is chiefly confined to the roads of Wayne County, Mich., and he holds that this experience has not been extended over a long enough period or over a large enough territory to make it conclusive as to the merits of the concrete road. He devotes his chief attention, therefore, to brick roadways, which he estimates can be built in New York State at an average cost of $25,000 per mile as a maximum, and can be maintained at an annual cost not in excess of $50 per mile.

In order to reduce the cost of building brick roadways, the Governor proposes to have paving bricks made by convict labor in the State prisons; and he thinks that by this means the cost per mile of brick roadways might be reduced to perhaps $15,000 per mile. On the above figures as a basis, the Governor computes a saving to the State of New York during the next 20 years, amounting to the enormous sum of $136,000,000, if brick should be substituted for macadam, in building the 7500 odd miles of New York State highways still to be built to complete the network of main roads all over the State.

Governor Glynn's presentation of the economic advantage of permanent roads over roads which involve a heavy annual cost for repairs, has been given in substance by engineers repeatedly; but coming from such a source it will, without doubt, have a weight with the public which no utterance by an engineer could have. Furthermore,

many engineers in charge of roadway construction have been slow to appreciate the great advantage of choosing types of roads of low repair cost; and no engineer could publicly make so strong a statement in favor of one particular type of material for roadway work without endangering his reputation for impartiality.

As often happens, however, when a layman undertakes to deal with technical matters, there are a number of features in Gov. Glynn's interesting statement which need some qualification before they can be accepted by engineers. Without questioning the soundness of his main position, it must be said that the selection of any single type of roadway for State road work, to the exclusion of all others, would greatly hamper the engineers in charge in securing the best results.

For example, a large part of the State roadway construction in New York involves considerable realignment and heavy grading. There are many places where it is better by far to lay a cheap temporary pavement of some sort, or even to leave it as an earth road, perhaps with a light dressing of gravel until the fill is thoroughly consolidated, the slopes have become permanent, and washouts in the gutters and down the sides are no longer serious. After a period of one or three or five years, it may be wise to lay a permanent and expensive pavement of brick or of concrete; but if laid at the start on a fill which is still to receive its final settlement, the result is very likely to be an uneven pavement with its surface cracked and broken, which will soon show the effects of a traffic and will require vastly more expenditure for its maintenance than the $50 per mile per annum assumed by Governor Glynn.

Again the extreme variations in the cost of roadways of different types are very much greater than the amount which Governor Glynn has assumed. While he does not state the width of roadway on which his estimates are based, it is evident that in order to justify an expenditure of $12,000 to $25,000 per mile in building a road, it must have a traffic heavy enough to make necessary a double-track width, or say, 16 ft., which is, in fact, a common standard in State highway construction. Such a roadway requires 9386 sq.yd. of surfacing per mile. The figures given by Governor Glynn for macadam, concrete and brick roads, respectively, might be assumed, therefore, to correspond to an approximate cost of about $1.20 per sq.yd. for macadam, $1.50 per sq.yd. for concrete, and $2.50 per sq.yd. for brick.

It must be remembered, however, that the figures per mile given above include usually many items beside the cost of the wearing surface. Whether a road is paved with concrete, macadam, or brick, it must have the same amount of work spent on grading, on drainage, on the paving of gutters, etc., on dressing and sodding of slopes, on guard rails at dangerous places, on bridges and culverts, and on such minor items as sign boards, warnings, milestones, monuments, etc., besides the engineering expenses in connection with surveys. All these are included in the twelve thousand odd dollars which the Governor assumes as the cost of macadam roads, making the actual cost of the wearing surface itself very much smaller than would be indicated on the face of the Governor's figures. The deduction from these facts, of course, is that the disparity in first cost between the macadam road and the permanent road of brick, is considerably more than would appear on the face of the returns.

It is probable that the concrete road deserves a larger place in the Governor's program than he has accorded it. It would not, of course, be wise for New York to embark on a large scale in concrete road building on the strength of Wayne County's experience alone, nor would it be wise to do so on the strength of its own rather unfortunate experiences in the laying and use of concrete roadways. There has now been accumulated, however, enough experience with the concrete road in a number of States in the Middle West, so that that type of roadway certainly stands vastly better with engineers than it did two or three years ago, particularly since this accumulated experience has shown that the best types of concrete roads, built under the best specifications as to material and workmanship and with proper inspection to see that the specifications are carried out, are giving on the whole admirable results.

Turning now to the Governor's advocacy of brick, the first point to be noted is that the range in cost of brick paving is very wide, even where it is laid under substantially the same specifications and with the same materials. This is due first to the large factor which the cost of hauling represents in the cost of brick pavement. Paving bricks sufficient to lay a square yard of road weigh in the neighborhood of a quarter of a ton. If the road is located where a long rail haul is necessary on the brick, and especially if a long wagon haul is necessary from the railway station to the place where the bricks are to be laid in the road, the cost per square yard of brick paving runs up very rapidly.

In the State of Ohio, where paving brick can be secured with a very short rail haul and where there are plenty of contractors experienced in laying brick paving so that sharp competition can be secured on paving contracts, the cost of first-class brick paving on a concrete base is in the neighborhood of $2 a square yard. Anywhere in New York State, a considerable addition must be made to these figures if a brick pavement as good as the Ohio pavements is to be laid. It is worth noting, too, that in order to secure the very low annual cost of maintenance on which Governor Glynn rightly lays so much emphasis, it is necessary that the pavement be laid in the best possible manner under the best specifications. Any attempt to cheapen the work by saving in the foundation or in the character of the paving material, or in the quality of the workmanship, usually has to be paid for eventually in increased cost of repairs.

How rapidly a long wagon haul raises the cost of brick paving is perhaps not always realized, even by engineers. To illustrate, if a wagon haul of 10 miles is necessary to deliver brick from the railway station to the point where they are to be used, and if the average cost of hauling the brick is 20c. per ton-mile, the cost of hauling the brick alone will amount to 50c. per sq.yd. of pavement. The concrete base will weigh nearly as much as the brick surface, so if the cement and sand and stone have also to be hauled this 10 miles, another 50c. will be added to the cost of the road. In most places in New York, however, the sand and stone can be obtained within a shorter distance of the work.

On the rail haul, while the trunk lines make a fairly low rate for paving brick, some of the local branch roads have of necessity to charge a considerably higher rate in order to make both ends meet. At the rate of four

mills per ton-mile, a haul of 500 miles will add another 50c. per sq.yd. to the cost of brick paving.

A year or more ago, the New York Board of Water Supply made plans to lay brick paving on the roadway around the Ashokan Reservoir in the Catskills. The engineers of the Board, after careful investigation, reached a conclusion similar to that of Governor Glynn, that to secure a minimum cost of maintenance, the extra first cost of a brick paving on this roadway was fully justified. The bids for the work, however, as we recall, showed prices as high as $3.50 per sq.yd. Paving brick from Ohio could be delivered by water at Kingston, from which port there was only a short rail haul over the Ulster & Delaware R.R., to the site of the dam. This local road, however, charged high freight rates, and there was a wagon haul for a considerable distance over rough construction roads from the railway station to the various points on the roadway to be built.

Governor Glynn proposes, in order to cut down the cost of brick paving, to have paving brick manufactured by convict labor. According to the New York State geologist, there are plenty of shales in southern New York suitable for paving-brick manufacture. The Governor recommends that an experimental plant shall be started in connection with the State Reformatory at Elmira and a bill appropriating $50,000 for this was introduced in the legislature. If it is true that the shales in this section of New York are suitable for making good paving brick, the Governor's message ought to lead to the establishment of numerous paving-brick plants in this section operated as a private enterprise. At present, the manufacture of paving bricks in New York State is an infant industry. The total output of the few plants in operation is trifling compared with that produced in Ohio. This is partly due, without doubt, to the fact that the merits of first-class brick pavement are not understood by the general public in the district east of the Alleghenies. It is probably due also to a lack of experience in paving-brick manufacture on the part of those in charge of some of the enterprises which have been started, and possibly also to some deficiency in the raw material in New York compared with that found west of the Alleghenies.

There is, however, a large possible market for good paving brick in New York and other Eastern states. If raw material is available for the industry, those who would engage in it as a private enterprise need not hesitate because of Governor Glynn's proposition to employ convict labor in the business. There are well known drawbacks in the use of convict labor. In the manufacture of paving bricks under modern conditions a very large part of the work is done by machinery. In a large paving-brick plant the shale is dug by a steam shovel instead of by human muscle; it is ground and mixed by machinery, and the bricks emerge from the brick machine ready to be placed in the kiln for burning. While a considerable amount of labor is employed in connection with paving-brick manufacture, a large part of it is highly skilled labor, requiring reliable and experienced men, and the use of convicts would involve a considerable element of risk. If we assume 75c. per sq.yd. as an average figure for the manufacturing cost of paving brick, it will be found that a large part of this cost must be charged to the items of fuel, supplies, repairs, and interest on the plant, general overhead charges, with superintendence and other skilled labor, leaving perhaps only half the cost, more or less, to be assigned to the ordinary labor employed. Even if this labor were obtained for nothing, therefore, by the employment of convicts, it would mean no such large saving in the cost per sq.yd. of brick paving as is assumed by Governor Glynn.

Besides this, the almost inevitable inefficiency in the conduct of a manufacturing plant run by state officials, who know very little about the business they are undertaking, will almost inevitably lead to larger operating expenses than would be necessary for a private concern run by an intelligent business man who knew every detail of the industry he was carrying on.

We might elaborate these reasons in much more detail, but enough has been said to show that Governor Glynn is much too sanguine in supposing that the cost of building brick roadways in New York State can be materially reduced by the use of convict labor in brick manufacture.

It is, however, by no means necessary that brick must be made with convict labor in order to establish the merits of brick as a paving material. Governor Glynn's remarkable message will doubtless have an important effect in bringing these merits to public attention, not only in New York, but throughout the country.

Letters to the Editor

Capacities of Intercepting Sewers in Relation to Future Sewage Flow

Sir—I have read with much interest the letter from Kenneth Allen in ENGINEERING NEWS of Mar. 5, 1914, and, if a foreigner may trespass upon your space, I should like to express an opinion in a very few words upon the subject of capacities of intercepting sewers.

I am quite in agreement with Mr. Allen when he says that "the entire plant should be designed with the maximum ultimate demands that may be made upon it, kept in view."

I strongly recommend that intercepting sewers be constructed of ample capacity at the beginning, and large enough to meet the maximum demand that may be placed upon them in the future. Due regard must, of course, be paid to maximum and minimum velocity in the sewer itself and within certain limits of velocity it is certainly wise to allow a large margin for future developments.

In Manchester, England, provision has been made for the next 45 years, and due regard has been paid to max-

imum concentration of rainfall and the possibility of outside townships using the interceptors by arrangement with the city.

It is much more economical to make the interceptors sufficiently large in the first instance than to construct supplementary sewers at a later stage; and I might add that after carefully calculating the maximum ultimate demand which is likely to be made upon the interceptor in the future, it would not be unwise to so design such a sewer that the interceptor would not run more than three-quarters full, and the maximum velocity should not exceed a figure previously laid down.

In my opinion, there should be a rapid runoff in any sewerage system and no possibility of sewers being placed under pressure at any part of the system, or seepage occurring and making itself felt at sewage outfall works for hours and days after heavy rains.

The foregoing proposition is only possible where the intercepting sewers are of ample dimensions. In order to arrive at a figure which will govern the design of such sewers, very careful and accurate observation must be undertaken by engineers of wide experience in such matters.

OSWALD J. WILKINSON,

Engineer to the Manchester Corporation Rivers Committee for the Sewage-Disposal Works Extension.

196 Deansgate, Manchester, England, Mar. 17, 1914.

More Concerning Publicity Work by Engineers

Sir—I have read with much interest C. E. Drayer's article on "Publicity," in ENGINEERING NEWS, of Jan. 22, your editorial comment and the various discussions of the article. It seems to me to be very important to the public and to the engineering profession that engineers should adopt a more sensible view toward publicity than they now have as a rule, and that engineers should take a more active part in educating the public. Mr. Drayer's article deals mainly with publicity through the newspapers. The same considerations which make it desirable for engineers to avail themselves of newspapers in a proper way also apply to publicity through more permanent literature, through magazines and books. They also apply fully to the passing on of ideas to others through ordinary conversation, through lectures and addresses, and to helping in the discussion of various local, state and national problems which involve engineering elements and on which the public action is apt to be wise or foolish according to whether the public has been informed or misled.

Much too frequently the engineer takes the attitude that he is not responsible if the public with which he is in touch is foolish in its handling of a local problem of which the proper solution is obvious to him. Too often he stands apart with superior knowledge and inferior action.

It is not sufficient for an engineer, or any other educated man, to *know*. He must *act*. A part of an engineer's duty is to help in molding public opinion by educating and guiding the public in those matters in which engineers by virtue of their training and occupation have superior knowledge.

Engineers know that it is foolish for any large city in which nearly 200 gal. per capita per day is being pumped into the water mains to fail to begin at once the general introduction of water meters. The engineer knows that in such a case much of the water is unnecessarily wasted. He knows that Chicago, for example, by wasting more than one-fourth of the water pumped into its mains greatly increases the cost of its water-supply and also makes the pressure insufficient in many parts of the city or even cuts off the supply above the third floor. The mistake of the public in this matter is based upon the notion that water should be as free as air, which is true. The engineer knows that the consumer is asked to pay for the transportation of water rather than for the water itself. In the case cited the water is transported from far out in the open lake to the consumer's faucet in the city. Few will claim that transportation should be free. In such a case as this, the engineer is in a position of advantage and should do his part in giving proper publicity to the facts, and so helping to overcome the opposition to water meters ordinarily encountered.

Many engineers know that much of the recent widespread condemnation of our railroads is unwarranted by the facts, that some of the existing and proposed legislation interfering with railroad management is unwise and a stumbling block in the way of what is needed, and that a considerable portion of the public is asking the railroads to perform utterly impossible feats. Should not engineers do more than at present to help the public to a proper sense of proportion in this matter?

Results are in direct proportion to the amount of usefully applied energy. The public opinion on matters primarily engineering in character may be molded by the engineer in direct proportion to the amount of energy which he applies to the education of the public in such a manner that it will be usefully applied energy, not lost in radiation in the form of vague or misunderstood statements, not lost in the friction of controversy, not lost in the high-pressure exhaust from private growling.

The primary benefits of energy applied by an engineer to publicity will accrue to the public. The secondary benefits are large and will accrue to the engineering profession and to the engineer.

JOHN F. HAYFORD,

Director, College of Engineering, Northwestern University.

Evanston, Ill., Mar. 10, 1914.

On the Compensation of Engineers

Sir—A comparison of the diagrams showing "Yearly Compensation of Engineers," in your issues of Jan. 22 and of Mar. 19, is certainly interesting. But the question arises, are they comparable?

The diagram in the issue of Jan. 22 is based on the incomes of men, the majority of whom are practicing engineering as a profession. By that I mean they are in business for themselves and not working for someone else on a salary.

The lawyer who is employed on a salary is rather the exception, and to keep him it is necessary to make his compensation something like what he can make in private practice. The same is true of the doctor.

I believe the income of engineers who are working under similar conditions will not compare unfavorably with those of men in the other profession. Indeed, the diagram referred to proves it.

The diagram in the issue of Mar. 19 claims to be for men working on a salary. That means, as income getters they are on an entirely different basis from the men covered by the former diagram. They are employed just as other clerks are and they compare with other clerks in compensation. I believe it to be true that the majority of engineers are on a salaried basis.

Some years ago, while I was working for one of the large railroad systems, a comparison of salaries was made. It showed that the men in the engineering department were getting neither more nor less than the men in the other departments. The same is true of most of the large corporations. This means that in the eyes of those fixing the compensation the engineering employee stands the same as a clerk or a bookkeeper.

The difference in compensation is controlled by the attitude of the public toward the man in question. Is he employed as a professional man or as a regular salaried employee? If he is paid fees, they will likely be ample, if a salary, it will likely be much less.

I presume many an engineer has experienced the difference. When he does work outside his regular employment he will get three or four times what he would have gotten for the same work in the regular course. Could he sell all his time at the higher rate, there would be very little cause for complaint. In other words, what people pay for is not engineering ability but selling ability. This is universally true and any effort to increase the compensation of engineers must take account of it.

In law or medicine, the man who lacks ability to sell his time is usually soon crowded out, in engineering he hangs on, on a salary. Indeed, in this aspect of it, engineering is not a profession but a business.

Are the diagrams of compensation in the two instances comparable? I do not believe we would lump the proprietor and the clerks together in any other business, in computing average incomes.

FRANK H. CLUTZ, Borough Engineer.

Chambersburg, Penn., Mar. 21, 1914.

Traffic through the Suez Canal

Sir—In your issue of Mar. 12, I note a statement in reference to the tonnage of vessels passing through the Suez Canal. The tonnage through the canal in 1912 is stated at 28,008,945; whereas, in "Whitaker's Almanack" it is stated at 18,324,800 net tons. I take it that the difference is due to your using "gross" tons. As the tolls are levied upon the "net" tonnage and, as the estimated tonnage through the Panama Canal is also quoted in the same way, it would seem preferable to use these figures rather than gross tonnage.

The fact that the Suez Canal, after 44 years of operation, passes less than 18½ million tons, makes Professor Emory Johnson's estimate that the Panama Canal will pass 10½ million tons during its first year of operation seem somewhat rosy, to put it mildly.

JAMES WHITE.

Ottawa, Ont., Mar. 23, 1914.

An Argument for State Registration of Engineers

Sir—The wide interest in the subject of engineers' compensation appears to show that the situation has become acute, and that measures must soon be taken to provide relief from the injustice of present conditions.

If engineers were not so deeply immersed in their own professional work, they would have long ago seen that the working of economic laws must eventually bring about the present situation. As long as no restraints are placed on men of any profession, trade or occupation, from underbidding their equals, just so long will the compensation of these men be kept down to a minimum fixed by that of the lowest bidder, which, in the long run, will be the lowest amount on which the lowest bidder can maintain the lowest standard of living to which he is willing to descend.

Notice that I say "equals," for men of superior ability can usually obtain more for their services than can their inferiors; but in any given level of ability, the compensation will be fixed by the lowest bidder in that class.

This economic law is now fully recognized by laboring men, who, by their unions, have raised the level of their compensation far above that which would otherwise exist. It is also recognized by such professional men as doctors, lawyers and dentists, who have succeeded in getting laws passed which limit the practice of their profession to those who are duly registered under state laws, and in good standing in their professional societies. It is not generally recognized by ministers, teachers and engineers, and, as a result, the salaries of ministers, teachers and engineers are far below their proper level.

There is, then, one clearly defined way out of the difficulty. Let us discontinue the practice of underbidding our equals, and let us organize to prevent ourselves being underbidden by those who are not our equals, but would represent themselves as such for the purpose of obtaining employment or professional work. Such an organization need not, and should not, be modeled after the labor unions, which seek to reduce all men in any given trade to a dead level of compensation and opportunity. It need not, and should not, shut out proper and fair competition based on the individual ability, experience and general attainment of individual engineers. It should, however, shut out the incompetent and the unprofessional.

I can see no reasonable objection to a system of state registration for engineers similar to that which prevails for doctors and lawyers. Surely it is more important that the engineer who designs a bridge or a dam be competent to do his work than that the lawyer who draws up some formal deed or agreement, or defends some criminal, be versed in the literature and practice of his profession. The objection that a civil engineer's license could not be made to cover the entire range of knowledge from that of the land surveyor to that of the designing engineer, seems to me as absurd as would be an objection to the present system of licensing medical practitioners because, under this system, a doctor is empowered to do anything from treating a cold in the head (fee $2) to removing an appendix (fee $2000).

The remedies, then, would seem to be:

1. A state license system admitting to practice in the profession only those who are competent.

2. An organization to determine the competency of those who wish to practice, decide upon cases of malpractice and unprofessional practice, and establish a schedule of fees and charges for professional work, and prevent competitive bidding for such work.

3. Laws requiring competent engineering design and supervision of works, so that it will no longer be possible for private parties who are totally ignorant of engineering principles to construct engineering works without employing competent engineers.

Unless some such course is adopted, I believe that, within the next few years, the younger engineers will be forced to organize for their own protection, adopting the methods of the labor unions to raise their wages ,and getting laws passed to raise the wages of those on public works. Already this is being done to an extent not fully realized by the older members of the profession. A general adoption of such methods would be deplorable, would, in the minds of the public, reduce engineers to the level of workers at a trade, and would stunt the opportunities of the young engineers for individual growth.

A. K. P.

Boston, Mass., Mar. 21, 1914.

Patents on Reinforced-Concrete Wharf Construction

Sir—In your issue of Oct. 9, 1913, you published an article by the writer concerning an economical wharf bulkhead construction, as built by the Savannah Engineering & Construction Co., at Savannah, Georgia. The publication of this article brought forth a considerable amount of discussion and correspondence, among other things bringing out the fact that Mr. George P. Wood of Peekskill, N. Y., held a patent on an economical wharf construction of somewhat similar type issued to him Oct. 12, 1909.

Mr. Wood has recently made the Savannah Engineering & Construction Co. sole licensee to handle his patent, and the Torrance & Cunningham patent, issued July 22, 1913, has been assigned to the same company.

W. M. TORRANCE.

123 William St., New York City, Mar. 20, 1914.

Government Railway Construction at Panama

Sir—The editorial in ENGINEERING NEWS of Feb. 26, entitled "Canada's Experiment in Government Railway Construction," must make very interesting reading for those who are inclined to be enthusiastic over government ownership of anything and everything.

We have a very good example of a government-built road on the Isthmus known as the Panama R.R. Relocation.

The building of the canal made it necessary to relocate about 40 of the 47 miles of the old Panama R.R. The numerous shifts and changes and rechanges and various other stunts pulled off brought the cost of the entire work up to about $9,000,000 or about $225,000 per mile on the average.

A very good single-track road has been the result, but no one can tell yet whether, when the canal is in operation, the traffic available for the road will amount to ten thousand tons a year or a million tons or more, or whether it will consist principally of colored market women and washer-women traveling back and forth, between the terminals.

Considering the cost of government railroad building in Canada and Panama, it will be very interesting to see how much of the "not more than 1000 miles" of Alaskan Railroad will be built with the "not more than $35,000,000" which Congress has allowed for that work. It is quite possible that conditions in Alaska may make construction work there even more expensive than in Canada or Panama.

W. T. M.

Paraiso, Canal Zone, Mar. 20, 1914.

NOTES AND QUERIES

In our report of the discussion of George A. Johnson's recent paper on Water Filtration (p. 641, Mar. 19, 1914) we stated:

> John A. Kienle (New York City), formerly of Wilmington, Del., questioned whether the cost of preliminary filtration (roughing filters) might not better be expended for sedimentation. He was convinced that mechanical filtration is better than slow sand filtration. He questioned whether the use of hypochlorite with mechanical filtration does not account for the high bacterial efficiencies now being obtained at mechanical filter plants.

Mr. Kienle informs us that he believes coagulation and not sedimentation would have been more efficient than roughing filters at Wilmington; also that he did not mean to have it inferred (as we did) that "mechanical filtration is better than slow sand filtration," but rather that without chlorination mechanical filtration is not, in his opinion, superior to slow sand filtration.

Notes from Engineering Schools

UNIVERSITY OF WISCONSIN—An engineering experiment station has been created by the Board of Regents. This will be established in the College of Engineering for the engineering, testing and research work of the college. The staff of the Station will consist of the Dean, as Director, and the members of the instructional staff in the various departments of the College of Engineering. In addition to these will be fellows, scholars, and assistants who may be engaged in experimental and research work. This will exclude members of the faculty of the College of Letters and Science, who are now members of the engineering faculty by reason of the fact that they give instruction to engineering students. This action transfers the appropriation for reasearch now made for the College of Engineering to the Engineering Experiment Station. The publication of experimental results at the station will be in the form of bulletins.

BROWN UNIVERSITY—The engineering courses are to be made broader, more comprehensive and also, for the first time, allowing some specialization. This is the result of changes in the curriculum proposed by the Council of Engineering Professors and approved by the Faculty. The changes, which affect the courses leading to the degree of Bachelor of Science in Civil, Mechanical and Electrical Engineering, involve the following provisions: (1) A concentration of the descriptive courses and the introduction of new required or optional courses in science or engineering; (2) better distribution of work throughout the four years; (3) making the graduating thesis optional—with the approval of the head of the department concerned; (4) provisions for electives in engineering and science during the Senior year.

Condition of Frame of Tower Building, New York, after 25-Yr. Service

The ten-story Tower Building, 50 Broadway, New York City, often called the first "skyscraper" or cage-construction building, has just been demolished, to make way for a new structure. The Tower Building was erected between June, 1888, and September, 1889, and thus has been in service almost exactly 25 years. The condition of its framework is a point of interest.

Bradford L. Gilbert was the architect. The Tower Building was 21½-ft. front, 39½-ft. rear, and 160 ft. deep. The frame consisted of cast-iron columns and wrought-iron floorbeams, with windbrace diagonals that seemed to have been put in as an afterthought. The floors were flat-arch terra cotta construction. The walls were carried on wall-girders in the lower five stories, but above this were self-sustaining. The wall-girders were double: an outer beam to carry half the wall load, and an inner beam to carry half the wall load and the floorload.

The exposure of the framework in the demolition showed it to be in excellent condition as regards absence of rusting. The four views Figs. 1 to 4 herewith illustrate the condition of the metal. The wrought-iron beams in general show virtual absence of rust. The cast-iron columns and the ⅜-in. cast-iron shell applied around them (as fire-protective covering) show localized patches of rust, and heavier rusting only at a few special points, such as the bolted two-angle windbrace connection, Fig. 4, where rust formed between the angles and the cast iron.

During the demolition of the building an engineer-inspector of the Bureau of Buildings, Manhattan, New York City, followed the work to note all interesting matters. The following are extracts from his report on the demolition work:

The building itself was of fireproof construction, or rather of construction considered as fireproof under the old code (prior to 1899). The structure was ten stories, basement and cellar in height, with terra cotta floor arches of the flat side-bearing type sprung between wrought-iron beams spaced 4 ft. 6 in. on centers. The columns were of cast iron 20 in. square with metal 1½ in. thick and were fireproofed by being incased with an outer shell of cast iron ⅜ in. thick. Field connections were all made with wrought-iron bolts; shop connections were riveted. The upper five stories of the structure were wall-bearing; the lower were inclosed in curtain walls. These curtains were supported at each tier on two sets of beams, the inner one being designed to carry the entire floor load plus one-half the weight of the wall and the outer beam the other half.

The foundation consisted of timber piles spaced in double row, 18 in. apart, and driven to hardpan. The heads of the piles were imbedded in concrete to a depth of 18 in. and were capped with granite, upon which the cast-iron bases of the wall columns rested.

FIG. 1. BEAM CONNECTION TO CAST-IRON COLUMN
(Framework of Tower Bldg., New York City, built 1888, removed last month.)

FIG. 2. FLOOR STEEL OF TOWER BLDG., SHOWING SLIGHT EXTENT OF RUSTING

. . . . . .

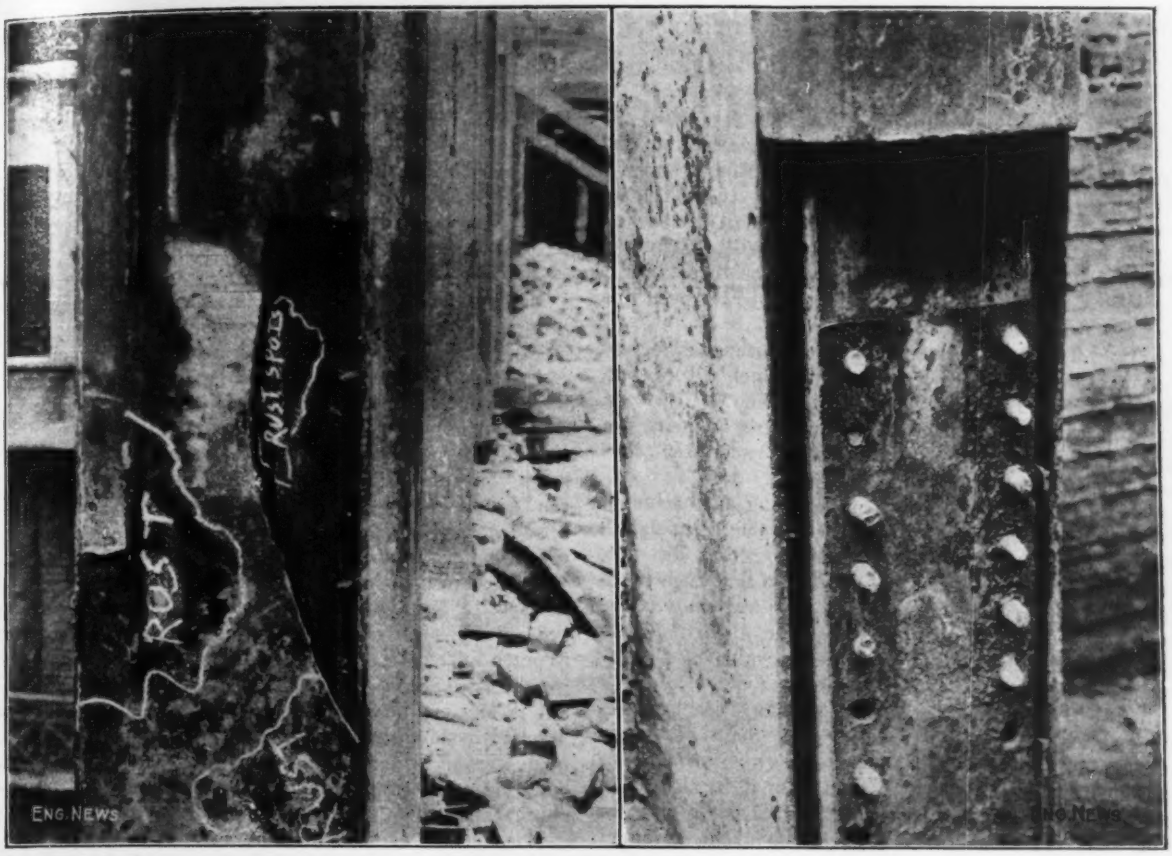
After a most careful and thorough examination it is safe to say that there was practically no case of very bad rusting, that is, of corrosion sufficient to impair the strength of the metal.

. . . . . .

[Fig. 4] shows the lower portion of a cast-iron column in the basement, to which had been connected the wind-bracing. The formation of rust at and around the bolts can be readily distinguished. This may be cited as the worst case of rusting in the Tower Building and exemplifies the fact that corrosion takes place readily at connections where two surfaces come in contact.

Concerning the floor construction and its connection with the condition of the floorbeams, the following paragraph is interesting:

No deafening material was used between the sleepers. The terra cotta did not cover the bottom flange of the floorbeams. The specifications for the setting of the floor arches probably required that the joints between the skewbacks and the iron beams be completely filled with cement mortar. To this may be credited the well preserved condition of the floorbeams.



FIGS. 3 AND 4. CAST-IRON COLUMNS OF TOWER BLDG., WITH CAST-IRON CASING AS FIRE-PROTECTION
(Bolted windbrace connection at foot of column, in Fig. 4.)

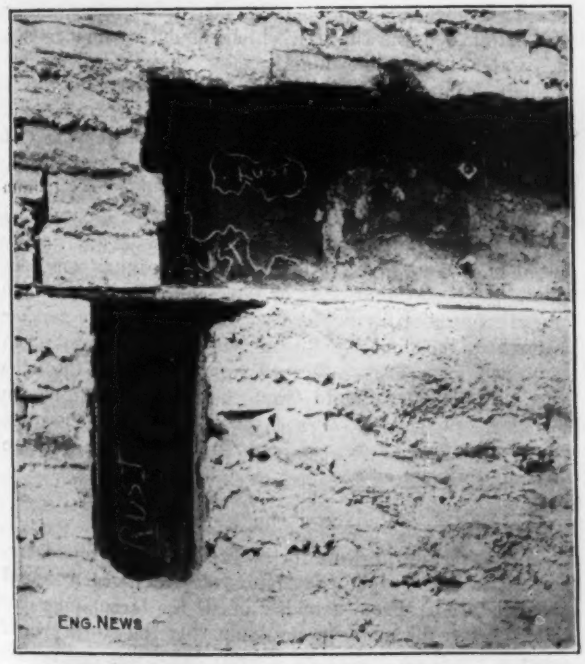


FIG. 5. STEEL COLUMN AND WALL-GIRDER OF BUILDING ADJOINING TOWER BUILDING

The demolition work also exposed some of the framework of the adjoining building, 56 Broadway, the Exchange Court Building, erected eight years later than the Tower Building. The condition of this steelwork is illustrated by Fig. 5, showing a steel column and wall girder. The rusting at the point shown is characterized in the report as severe, but it is attributed to defective flashing at the roof of the Tower Building, which permitted water to percolate through and enter the vacant space between the independent walls.

⁂

Highway Construction and Maintenance Costs in Europe— Dr. R. L. Hewes, Chief of Economics of the United States Office of Public Roads, in a recent address to the Motor Truck Club in New Cork City, gave some important points to be borne in mind when the comparative costs of transportation over roads in this country and in Europe are under discussion. Dr. Hewes is reported by the New York "Times" of Feb. 22, as follows:

In arguing for improvement in highways, we often see the statement of the very low cost of hauling on the Continent of Europe. It is very doubtful if any better roads are built in Europe and England at present than the best types of roads constructed in this country. The reason for the excellence of the European roads is because of their continuous maintenance, but the same degree of maintenance in this country will cost many times as much as it does in Europe. We cannot hire road patrolmen for the price paid the cantonnier on the national French roads.

These men receive a salary of less than $300 per year for taking care of from four to five miles of highways; furthermore, the costs of European roads, that are always compared with our costs to a disadvantage, are not as low as they are made to apear. Just as the labor or maintenance is cheaper, so is all labor cheaper in Europe, and there must be supplied a factor of at least one and a quarter in most cases to bring the cost of ton-miles hauled in Europe to a parity in this country. The 10c. per ton mile in Europe at least represents 14c. in this country, and hauling on graveled roads was done as low as 13c. per ton-mile in Virginia last year.

Engineering Lessons from the Ohio Floods*

By John W. Alvord†

The great floods of March, 1913, which devastated the states of Indiana and Ohio, will always have a direct and intense interest for engineers, and the importance of having the data carefully recorded and studied is obvious. A government board is working on the general problems and it is hoped will fully develop all the further lines of inquiry which should probably be made. It is generally agreed that the main lessons to be learned from the recent great floods are as follows:

First, That there should be some authoritative and adequate public control of our streams which will prevent encroachment by bridges, buildings, populated territory, railroad embankments and dangerous levee systems, not only upon the low-water channels but upon the flood plains as well.

Second, That where relief from existing encroachment is required, it should be accomplished through legislation authorizing the formation of flood-protection districts, preferably covering entire watersheds, so that each problem as a whole can be given proper technical study. The cost of flood-protection work should be apportioned in some fair relation to the benefits and value of the affected interests.

Third, That, while Indiana and Ohio cities have recently received a severe object lesson, there are many other cities and towns in this country which have so encroached upon the adjacent river beds as to be already in peril. They should not be permitted to await a physical demonstration of their danger, but should be aroused to the problem of protection from destructive floods.

Fourth, The studies at Columbus and Dayton, as far as made, indicate that radically different methods of treatment are often required for communities apparently similarly situated.

Reservoir Panics

With the perils and distress of the flood, there came to nearly all the inhabitants of both Dayton and Columbus a panic produced by the rumors that important reservoir dams had given way. After the strain, which nearly everybody involved had been under, it is not strange that even strong-minded people should have been ready victims of such a rumor.

No one could understand where such a vast quantity of water could have come from. In Dayton, the water was at least 8 ft. higher than anyone could remember it to have been before, and the immediate thought was that the reservoir dams upon the upper watersheds had given way and added to the already dangerous floods. An untold amount of mental suffering was produced for some hours in both Dayton and Columbus by this fear.

It is a question whether the terror inspired by these panics will permit those populations to calmly contemplate the construction of great reservoirs on the watersheds above their cities for the purpose of protection. Where such structures are plainly the most economical and efficient way of controlling floods, they must be very ample in their proportions and stable in their design if they are to receive the confidence and approval of the people.

Another engineering lesson which can be profitably drawn from these flood scenes is the necessity of providing free waterway under bridges for débris. All great floods are drift-laden, and houses, barns, fences, haystacks and wreckage of all kinds quickly lodge where an insufficient waterway is provided, still further reducing the area.

Rock Erosion at Columbus Dam

Perhaps no other effects of this great flood show the intensity of the forces at work as do those resulting from the overflow at the Columbus storage dam. It is roughly estimated that the flood in its passage over this dam and through Columbus would, theoretically, have created over a million horsepower, the larger part of which was dissipated in internal work of the rolling water. Great rocks, some of over three tons weight, were quarried from the bottom of the river, carried downstream some hundred feet, and piled up in a dike. The rock at this point is laminated limestone, lying in nearly horizontal strata.

A survey which has been made indicates that in places at least 10 ft. of solid ledge rock was removed from its bed. It does not appear that the stability of the dam is much affected so far, as it is unusually strong both in weight and profile for the head which it has to carry, but to any engineer who is constructing dams, and who has had to do with the enormous forces created by large quantities of water rolling over crests, these facts are certainly significant and instructive, and may be profitably recalled when designing similar structures.

The average rainfall on the watershed above the Columbus dam was 9.34 in., while the runoff was 8.63 in., giving a runoff of 93% of the rainfall.

At Columbus, it was also necessary to measure the flow of the Olentangy River. The best opportunity for this was at Delaware, about 25 miles above Columbus, where at a bridge opening through which the entire flood passed the water marks above and below were distinctly recorded. The bottom of the river being rock, there was no considerable change of cross-section, except that due to the destruction of the center pier of the bridge and some erosion of the roadbed of the Pennsylvania R.R. which passes under the western span. The conclusions as to the flow of the Olentangy are not based upon so secure data as were available for the flow of the Scioto, but it is evident that the flow of the Olentangy was considerably greater than that of the Scioto per square mile of drainage area, as might be expected from its smaller watershed, the final conclusion being that the two rivers combined gave 89 sec.-ft. per square mile of drainage area. The Upper Scioto from the measurement at the storage dam yielded 77 sec.-ft., while the Olentangy, measured at Delaware, yielded 115 sec.-ft. per square mile of drainage area.

Projects for Relief

In considering projects for relief, it was, of course, important to decide upon the factors of safety which should be introduced. From a review of all the large storms in this country, there can be no doubt that the storm which covered the Ohio Valley in March, 1913, was one of the very great storms; nevertheless, it is easy to see that all of the factors producing large storms were not present.

*Extracts from a paper read before the Boston Society of Civil Engineers and published in the Society's "Journal" for March.

†Consulting Engineer, Hartford Building, Chicago, Ill.

If the heaviest precipitation had occurred entirely within the Ohio Basin, or within any one of the different tributaries, or if the precipitation had occurred with a great depth of snow on frozen ground, the runoff would have been greater and more sudden than was actually the case.

On one part of the Scioto watershed there was in operation a large natural restraining reservoir, which caused the water from the upper watershed to be detained, and which prevented additions to the crest of the flood, and further, 3 in. of the total rainfall ocurred after the crest of the flood had passed Columbus. Under these circumstances, we must admit that the flood of March, 1913, might be materially exceeded in the future.

It is interesting, as bearing on the general proposition of reservoirs for flood relief, to note how the different conditions in Columbus and Dayton pointed toward different solutions of the proposition. For Columbus, projects with a fraction of the flood stored in reservoirs, combined with channel improvement, were found to be not materially cheaper than a channel-improved project alone, but in Dayton the Morgan Engineering Co. has found that supplementary channel projects are so expensive, and available reservoir sites so much nearer the full flood capacity required, that everything now seems to point to reservoirs as the proper solution there, while channel improvement is the proper solution for Columbus, considered by itself.

There is one reservoir proposed on the Stillwater River above Dayton, which will hold over 12 in. of rainfall from the watershed above it, and another, on the Mad River, has a capacity for 6 in. of rainfall on the watershed above it.

It is hard to realize the magnitude of these reservoirs for full flow. In the March, 1913, flood the Dayton reservoirs would hold 1,500,000 acre-ft., and the Columbus reservoirs 750,000 acre-ft. To safely store this vast amount of water in close proximity to the city is indeed a problem.

Detaining Type of Dams

All of the proposed Columbus dams are to be of the "detaining type"; that is to say, constructed with large openings in their bases which will permit light floods to pass freely through them without detention, while larger floods will be partially detained, and great floods more largely detained. It is obvious that the greater portion of the lands above this type of dam would not be flooded except when a quite large flood occurred, so that, with reasonable precautions, they could usually be cultivated. It is not, therefore, necessary to devote such lands entirely to reservoir purposes, but it is evidently necessary that the land should be owned and controlled for the purpose for which it is designed. *"Calamity reservoirs,"* as we may properly call them, should not be filled for any other purpose than to detain great and destructive floods, unless a certain definitely defined proportion of them be conserved for other purposes and excluded from consideration for flood-protection purposes. Whether this is safe and certain under our American municipal conditions is an open question.

The adoption of the detaining type of reservoirs at Columbus was largely due to the desire to avoid reliance on human vigilance, thus all operated types of flood relief were excluded from consideration as a matter of principle. In works which are only to be used once in twenty-five or fifty years, it does not seem prudent to rely upon human vigilance. Much cost might be saved if certain types of control gates and emergency dams could be introduced in works in the city and for channel improvement, but all of these were discarded, under the circumstances, as being unsafe and improper of application to a problem of this kind.

It is also to be questioned if great outlet gates are practicable in emergency dams, or so called "calamity reservoirs." Such gates must necessarily be very large, exceeding in size most of those now used, and operated by power, as they must be, and at infrequent intervals, their introduction is questionable.

The Recommended Project at Columbus

The recommended project at Columbus might be described as a "channel straightening project." The West Side, consisting of a long, narrow, populated area crossing the valley like a dam, is to be crossed by a proposed new channel about 6000 ft. long, 900 ft. wide at the top, and 600 ft. wide at the bottom. Above and below this new channel the river is to be confined by levees, converging to the channel on the upstream, and diverging from it on the downstream side, so that the flood may gather itself together for its flow through the channel, then spread itself out again upon the flood plain below the city. A mean velocity of 8 ft. per sec. was considesred the highest desirable within the artificial channel, and 10 ft. mean velocity was considered the limit for bridge openings.

The cost of the recommended project was over $11,300,000, of which about $8,500,000 would be represented by the city's outlay and the balance by the railroads and other interests.

The city of Columbus has already voted upon a proposition to issue eight and a half million dollars' worth of bonds to initiate this improvement, and while considerably over a majority were in favor of the proposition, the law in Ohio requires a two-thirds majority, which was not attained. People from the flooded district voted for the proposition almost to a man, but other members of the community residing on higher ground did not appear to relish the proposition to pay for the work with a blanket bond issue, the proceeds of which would be very largely used in one section and that the least valuable in the city; consequently enough votes were cast against the measure to defeat it.

Holing Through of the Silver Lake Tunnel, Catskill Aqueduct—At noon, Tuesday, Mar. 31, the last tunnel on the Catskill Aqueduct, New York City, was holed through, with appropriate ceremonies, followed by luncheon, at which the contractors, the Beaver Engineering & Contracting Co. and P. J. Morani, Inc., were the hosts to many prominent officials of the Board of Water Supply and other invited guests. The Silver Lake tunnel is a short link in the Richmond conduit, leading to the Silver Lake reservoir on Staten Island, a description of which was published in "Engineering News," Feb. 5, 1914, p. 279. The intake tunnel is to be horse-shoe shape in cross-section 4x4 ft., with a smaller blow-off drain beneath. The tunnel for the most part was through very soft material and some very rapid progress was made. Following the hearty repast furnished by the contractors, speeches and toasts were made by Commissioners C. N. Chadwick and John F. Galvin, of the Board of Water Supply, Deputy Chief Engineer, M. H. Smith, Department Engineers Walter E. Spear, Alfred D. Flinn and others of the engineering staff. Walter F. Drummond, President of the Beaver Engineering & Contracting Co., P. J. Moranti, contractor for the tunnel work, and others spoke for the contractors.

Roads of Brick or Concrete Instead of Macadam for New York State Highways

We briefly noted on p. 705 of our last issue, Gov. Glynn's special message to the New York legislature, on Mar. 23, urging that the State abandon the construction of macadam surfaces on State highways, and lay instead brick or concrete paving. The Governor presents figures indicating that by this change, the State would save on the 7300 miles of State roads still to be built no less than $146,000,000 in the next twenty years.

This great saving results mainly from the disparity in the cost of maintenance between macadam roads, which the Governor estimates will cost $1,000 per mile per annum to maintain, and brick roads, which he thinks can be maintained at an average cost of $50 per mile per annum.

Gov. Glynn also urges the use of convict labor, not in the construction of the roads, but in the making of the brick, and of paving blocks from Medina sandstone.

We print his message nearly in full below and have commented upon it in our editorial columns.

Governor Glynn's Message

New York is engaged in building 12,000 miles of road which will wear out 40 years before they are paid for. [The State road bonds run for 50 years.—Ed.] Unless the State makes a radical change in the type of road it builds, it will cost from $20,000,000 to $30,000,000 yearly to maintain and rebuild New York's highways when the present system is completed.

It costs New York approximately $12,000 to build a mile of macadam road which, under present traffic conditions, will not last more than ten years. It costs a thousand dollars a year to maintain and resurface these macadam roads. And, at the end of ten years when these roads are worn out it will cost at least $6000 a mile to rebuild them.

One hundred million dollars has been voted for the construction of New York's highways. If the roads we build in the future cost as much as those we have been building in the past, it will require an additional $30,000,000 to complete the proposed system. On New York's 12,000 miles of macadam roads the annual cost of maintenance will be $12,000,000, the total cost of the roads will be $130,000,000 and at the end of ten years from the date of completion the State will have little to show for an expenditure of $250,000,000.

In the twenty years thereafter the tax for highways will be at least $20,000,000 each year, if our roads are to be kept in proper condition.

Every year the taxpayers of New York will be compelled to pay $12,000,000 for maintenance. Every year they will be forced to pay $5,000,000 in interest charges on their bonds. Every year they will be compelled to contribute $2,500,000 to the Sinking Fund to take up these bonds when they mature. And every year they will be required to pay additional millions to rebuild part of the roads on which they are lavishing these tremendous sums.

In other words, New York must either change its road policy or prepare to levy a perpetual yearly road tax of $2 on every man, woman and child within its borders.

Effect of Motor Traffic on Roads

When the State planned its highway system it did so without knowledge of the motor traffic that these roads would later be asked to withstand. Following the lead of Massachusetts it adopted a system of macadam roads eminently fitted to light horse traffic but utterly unsuited to the wear and tear of the heavy automobile. The result has been that an ever increasing motor traffic is pounding the roads of New York apart almost as fast as they can be built. What the State has saved in the initial cost of its roads is more than lost in the great and increasing cost of maintenance.

New York's experience has simply been that of adjoining States but upon a larger scale. New York pays no more than Massachusetts does for the same kind of macadam road. New York's macadam roads last as long as roads in Massachusetts that are subjected to the same degree of traffic. Last year Massachusetts spent over $800 a mile for repairing and resurfacing and many older roads needed rebuilding at a cost of from $6000 to $10,000 a mile.

New Jersey builds its roads at an approximate cost of $10,000 a mile, but it is fortunate in the possession of domestic road material which other States must import. For repairs and resurfacing, New Jersey spends over $1500 a mile.

Permanent Roads of Brick or Concrete

Instead of roads that wear out in ten years, New York must build roads that will last from twenty to thirty years. Instead of building highways that cost $1000 a year to maintain, New York must construct roads that can be maintained at a moderate annual cost. Two types of road with which this country has had experience answer these requirements. One is the concrete road, the other the brick road with the concrete foundation.

In the past, New York has been slow to adopt concrete or brick roads because of their high initial cost. Where a macadam road costs from $10,000 to $13,000 a mile to build, a concrete road costs from $12,000 to $16,000 a mile, and a brick road costs from $20,000 to $25,000.

Unfortunately, the experience of the modern road builder with concrete has been rather limited. Michigan has built concrete roads in one county and thus far has obtained very satisfactory results, but these roads have not been down long enough to justify any positive conclusion as to their permanence and economy. Brick roads, however, have been laid in hundreds of cities and have everywhere demonstrated their durability. Brick roads have been down for 25 years and have admirably stood the test of the hardest kind of traffic. The annual cost of maintaining these brick roads has been remarkably low, ranging from practically nothing to from $10 to $50 per mile.

Even if New York were compelled to pay $25,000 a mile for brick roads it would be economy to build such roads instead of macadam roads in all places where the State's highways are subjected to heavy automobile traffic.

The total expenditures for 20 years on a macadam road amount to $36,000. This includes $12,000 for building, $18,000 for maintenance, and $6000 for rebuilding at the end of the first ten years.

The total expenditures for 20 years on a vitrified brick road amount to $26,000 if we allow a maximum of $25,000 for building and $50 a year for maintenance.

On these outside figures the difference in cost for 20 yr. between the macadam and brick roads shows a balance of $10,000 in favor of the brick road even if New York pays the market price for brick.

Making Cheap Paving Brick with Convict Labor

I believe, however, that by judicious legislative action it is possible for New York to build brick roads for a little more than it now costs to build macadam roads.

The greatest item in the construction of brick roads is the cost of the vitrified brick. If the State can secure this brick cheaply, its road problem will be solved. In a brick road costing $25,000 a mile, the brick itself costs $12,000.

New York can make its own brick by utilizing the splendid deposits of shale which are found in profusion all through the southern half of the State and by using prison labor to turn this natural resource into paving blocks.

I respectfully suggest to the Legislature that it amend the Prison Law so that the State's prisoners may be employed in the manufacture of brick for the State's highways. The State Geologist informs me that:

> New York State has an inexhaustible and widely distributed resource in shale which may be made the basis of an industry large enough to supply all the local requirements in paving material of the best quality. The value of this resource has been recognized by private enterprise, and for the last twenty years paving brick has been manufactured on an increasingly large scale. The local product comes in competition with that made in Pennsylvania, Ohio, Michigan and other states, and the test of experience generally appears to justify the opinion that the brick made in the New York plants compare favorably with the best in the market. Practically the whole of the southern half of the state between the meridian of Buffalo and Albany and the Pennsylvania State line is underlaid by formations that include shale among the more important members.

At Elmira, where the State Reformatory is located, there are deposits of shale particularly fitted for the purpose I suggest. It would be easy to make an experiment there to determine beyond any doubt the feasability and economy of using prison labor in the manufacture of paving brick. The plant necessary for the manufacture of vitrified brick is comparatively simple and inexpensive.

I urge the Legislature to appropriate, at once, enough money to try out at Elmira the plan I have outlined. I recommend that the Legislature appoint a legislative committee to investigate the entire question.

New York would be merely following the enlightened and economical system of sister commonwealths if it employs its prisoners to make the brick needed for its highways. In Illinois, Iowa, Maryland, Massachusetts, Michigan, New Jersey, Utah and Wisconsin, prisoners are used in the preparation of road material.

Many States go further and employ the prisoners of the State to a greater or less extent in the building, repair and maintenance of their roads.

I am not suggesting that New York employ its convicts in the actual construction of its highways. I firmly believe that the State's roads should be constructed by free labor either working under contractors or in the employ of the State itself, but I also believe that the State should, so far as practicable, secure the material for its highways by the labor of its prisoners.

Those who are qualified to speak, inform me that by securing the vitrified brick for New York's roads in this manner, brick roads can be constructed at a cost of $15,000 a mile.

On this basis, the total cost of a mile of brick road for 20 years would be $16,000, including $15,000 for building and 20 years of maintenance at $50 a year. The total cost of a macadam road for the same period, as I pointed out, is $36,000

An idea of the importance of the economy I propose may be gained from the fact that the total saving in the 7300 miles of road yet to be constructed would amount to $146,000,000 in the 20 years after their completion, or more than the total cost of constructing our entire system of highways.

Paving Blocks of Medina Sandstone

A careful study should also be made of the feasibility of utilizing Medina sandstone blocks for road construction. This stone has been used for permanent pavement for a great many years. Main street in the city of Rochester, and a number of streets in the city of Buffalo and elsewhere have been successfully paved for 20 or 30 years with this material. The State in acquiring lands in connection with the Barge Canal has obtained property from which this stone can be procured and cheaply transported where desired. Medina sandstone blocks, I am advised, can be made with convict labor and the use of machinery as cheaply as brick, and afford as good, if not a better wearing surface.

Road Location and Bridge Maintenance

A legislative committee should make a careful study of our road problems.

I believe such a committee as I suggest could, without interfering with the provisions of the highway referendum, or the constitutional amendment for highways, save the State at least $15,000,000 by a readjustment of designated highways, many of which needlessly parallel one another. It should also be able to map out a plan, satisfactory to the State and profitable to the towns, for the construction and maintenance of bridges in connection with the highways. It is unfair to compel towns of small financial means to build and maintain expensive bridges used by the people of the State at large. We need a new system of highway patrol and section supervision similar to the systems of England and France.

Far-seeing, constructive legislation is needed to prevent the squandering of millions of dollars of the people's money upon roads which are not needed in some instances, and which in all instances will not stand up under the present grind of heavy automobile traffic. New York should have good roads, but the only way to have good roads is to have only roads that New York can afford to maintain.

I shall expect and shall exact results from the Highway Department during the coming summer. I shall do whatever I can as Governor to see that the State receives the full value of its money in all roads built during my administration. But the highway problem cannot be settled in any single administration if the general plan is wrong.

In view of the facts that I have presented for your consideration in this message, it must be conceded that our present methods of construction for most of our roads are unfitted for existing conditions.

Opinion of the New York Court of Appeals on Going Value, Paving over Mains, and Appreciation as Income in Rate Cases

The Public Service Commission for the First District of New York, in the case of complainants against the Kings County Lighting Co., of Brooklyn, made a valuation for rate-making purposes, as discussed in ENGINEERING NEWS, Nov. 16, 1911. Several points were contested by the company, notably, failure to include a "going value," or cost of improved paving over mains (laid since the mains were put down). The Commission also entered as an item of income the annual appreciation in land.

As noted in ENGINEERING NEWS, Aug. 21, 1913, the Appellate Division of the State Supreme Court reversed the determination of the Commission on all of these points. The Commission appealed and the Court in granting leave to appeal certified these same questions for review by the Court of Appeals, which is the highest court in New York.

This court, on Mar. 24, 1914, rendered an opinion on these questions, affirming that the company was entitled to an allowance for going value in the basis for rate, but that it was not entitled to include the cost of paving not in place at the time the mains were laid. The court denied that, upon the facts shown in the record, an annual appreciation of land should be considered as a part of the gross receipts from yearly operations. As the decision is of wide interest and the latest word on several disputed questions, some pertinent paragraphs are reprinted below. The opinion is written by Judge Miller, the rest of the Court unanimously concurring.

GOING VALUE—It is now generally recognized that "going value," as distinct from "good will," is to be considered in valuing the property of a public-service corporation either for the purpose of condemnation or rate making, but there is a wide divergence of view as to how it is to be considered. The commission in this case says it was taken into account in valuing the plant as a "going" and not as a "defunct or static" concern and that it was also considered in fixing the fair rate of return. The Appellate Division says that there is no proof of the latter fact in the record. Thus the first question certified requires us to decide whether "going value" is to be appraised as a distinct item, or whether it is sufficient to regard it as something vague and indefinable to be given some consideration, but not enough to be estimated. The valuation of the physical property was determined by ascertaining the cost of reproduction less accrued depreciation. Preliminary and development expenses prior to operation were included, but no allowance was made for the cost of developing the business. By that method the plant was valued in a sense as a "going concern." In other words "scrap" values were not taken; but to say that that sufficiently allows for "going value" is the same as to say that "going value" is not to be taken into account. * * *

The first question certified then resolves itself into two heads: 1. Is "going value" a distinct item to be appraised and included in the base upon which the fair return is computed? 2. Was the evidence in this case sufficient to justify an allowance for it?

The opinion of Mr. Justice Clark below saves me the necessity of citing and analysing the cases bearing on the first branch of the question. We concur fully in what he has said on the subject and in his conclusion that there is no "logical difference between allowing going value in the valuation of a plant when it is to be taken entirely by the public and allowing the same element when valuing the same plant for rate-making purposes."

It is no answer to say that in condemnation cases the exchange value is taken, and that that depends on the rates charged, the thing to be determined in rate cases. Of course, a rule of valuation might be adopted in a condemnation case which would not work in a rate case; but if the cost of reproduction less depreciation rule be adopted, as appears to have been done in National Waterworks Co. vs. Kansas City (62 Fed. Rep. 853) and Omaha vs. Omaha Water Co. (218 U. S. 180), the leading condemnation cases in the Federal courts in which "going value" was considered, it is impossible to see why the "going value" could not be determined in both classes of cases in precisely the same way.

The difficulty of determining the "going value" will not justify the disregarding of it. Rate making is difficult. But that will not justify confiscation. The difficulty, however, will lessen, as it does in most cases, when we cease to think about the subject vaguely. What then, is "going value," and how is it to be appraised?

It takes time to put a new enterprise of any magnitude on its feet, after the construction work has been finished. * * * The company starts out with the "bare bones" of the plant, to borrow Justice Lurton's phrase in the Omaha Water Works Case (supra). By the expenditure of time, labor and money, it coördinates those bones into an efficient working organism and acquires a paying business. The proper and reasonable cost of doing that, whether included in operating expenses or not, is as much a part of the investment of the company as the cost of the physical property.

The investors in a new enterprise have to be satisfied as a rule with meager or no returns, while the business is being built up. In a business subject only to the natural laws of trade, they expect to make up for the early lean years by large profits later. In a business, classified among public callings, the rate-making power must allow for the losses during the lean years, or their rate will be confiscatory and of course will drive investors from the field. In the former class, the value of the established business is a part of the "good will" and may be determined by taking a given number of years' purchase of the profits, or exchange value may be considered. In the latter case, a different rule must be adopted.

Referring again to the Ames Case [169 U. S. 466] the public is entitled to be served at reasonable rates, and the corporation is entitled to a fair return on the property used by it in the public service, no more, no less, always assuming, of course, that the return is computed on a proper valuation. That was not made so by statute, but was the rule at common law, which justifies legislatures and commissions in fixing rates. If then a public service corporation has received more or less than a fair return, it has received more or less, as the case may be, than was its due, irrespective of whether a rate had been fixed by public authority. If a deficiency in the fair return in the early years was due to losses or expenditures which were reasonably necessary and proper in developing efficiency and economy of operation and in establishing a business, it should be made up by the returns in later years. If there was a fair return from the start the corporation has received all it was entitled to, irrespective of how much of the earnings may have been diverted to the building up of the business. * * * The first question, therefore, to determine on this branch of the case was whether the company had already received a fair return on its investment. If it had received such return from the start, or if in later years it had received more than a fair return, the public would already have borne the expense of establishing the business in whole or in part, and to that extent the question of "going value" for the purpose of fixing a present rate would be eliminated; for it must constantly be kept in mind in dealing with this problem that the company is entitled to a fair return and no more. If it has already had it, that is the end of the matter. If it did not receive a fair return in the early years owing to the establishment of the business, a subsequent rate must allow for that loss or it will be confiscatory. Now, no dividends appear to have been paid by the original company or by the relator prior to 1907. Assuming a reasonable need of the service from the start, and that the failure to pay dividends was not due to the management, an accumulation of a surplus or undivided profits, the investment of earning in permanent additions or betterments allowed for in the structural valuation, or to other causes besides those under consideration, none of which is asserted, it would seem plain that "going value" was an element in this case which the commission was required to determine in making an appraisement on which to compute the fair return to which the company is entitled.

It is urged that an unprofitable business will thus have a greater value for rate-making purposes than one profitable from the start. That again overlooks the fundamental consideration that a public-service corporation is entitled to a fair rate of return from the beginning of its investment and no more. * * * We are dealing, not with exchange values,

but with the value upon which the company is entitled to earn a return. In this connection it is to be observed that the statements in the opinions of the courts, in reference to computing the fair rate of return on present values, have for the most part been made in cases in which the precise question under consideration was not directly involved, and in which no attempt was made to limit the elements composing the problem. * * * The term "going value," though not exactly defined, has been used quite generally to comprise the elements not included in the structural value of the property in its present condition. The term is not important. The point is that in some manner and under some appropriate heading a due allowance must be made for the investment in those elements. No inflexible rule will in the long run be just both to the public and the corporation. The right to limit the corporation to a fair return fixed by public authority necessarily involves the correlative right on the corporation to be assured of that fair return during all the time that its capital is employed in the public service. * * *

Making proper allowance for the matters just considered and perhaps for others which do not now occur to me, I define "going value," for rate purposes as involved in this case to be the amount equal to the deficiency of net earning below a fair return on the actual investment due solely to the time and expenditures reasonably necessary and proper to the development of the business and property to its present stage, and not comprised in the valuation of the physical property.

It may be conceded that going value has no existence apart from tangible property and that commercially there is is but one value, that of the property as a whole, but as the rate cannot be made to depend upon the exchange value, which would in turn depend upon the rate, it would seem to be necessary to appraise the physical property and the going value separately, and of course that is the case if the cost of reproduction rule be adopted.

It remains to consider how "going value" is to be appraised. That presents a question of fact, the determination of which is primarily within the province of the rate-making body. It is proper for this court, however, to indicate a permissible method or methods.

Obviously, the most satisfactory method is to show the actual experience of the company, the original investment, its earnings from the start, the time actually required and expenses incurred in building up the business, all expenditures not reflected by the present condition of the physical property, the extent of which bad management or other causes prevented or depleted earnings, and any other facts bearing on the question, keeping in mind that the ultimate fact to be determined is not the amount of the expenditures, but the deficiency in the fair return to the investors due to the causes under consideration. The business in this case was twenty years old, the books of the old company were not available, and it is of course problematical whether, if produced, they would have shown the necessary facts. The question, therefore, had to be determined, as all questions of fact have to be, by the best evidence available. Here, I may repeat that mere difficulty in the proof would not justify a confiscatory rate. The value of the physical property was shown by opinion evidence as to the cost of reproduction. * * * Of course, the commission was not bound by that evidence. It had in addition the experience of the relator and its predecessor as to payment of dividends, the amount of capitalization of both, and the value of the physical property in its present condition determined as above stated. With nothing opposed to those facts and the opinion evidence it was not justified in ignoring the evidence of "going value" or of merely attaching some inappreciable importance to it. (See Bonbright vs. Geary, 210 Fed. Rep. 44, 54, 56).

PAVING OVER MAINS—In determining the cost of reproduction the commission allowed $12,717 as the cost of restoring the pavement as it existed when the mains and service pipes were laid in the streets. The relator claimed an allowance of at least $200,000 for the cost of restoring pavements subsequently laid on the theory that that cost would have to be incurred if the mains were to be laid today. But the new pavements in fact added nothing to the property of the relator. Its mains were as serviceable and intrinsically as valuable before as after the new pavements were laid. The controlling considerations under the preceding point also determine this. The rights of the public are not to be ignored. The question has a double aspect. What will be fair to the public as well as to the relator? (Smith vs. Ames, supra.) Should the public pay more for gas simply because improved pavements have been laid at public expense? It is no answer to say that the new expensive pavements suggest improved conditions which, though adding to the value of the plant, will not, by reason of the greater consumption, add to the expense per thousand feet of the gas consumed. The public is entitled to the benefit of the improved conditions, if thereby the relator is enabled to supply gas at a less rate. The relator is entitled to a fair return on its investment, not on improvements made at public expense. It is said that the mains will have to be relaid. So will the new pavements, and much oftener. Both might possibly be relaid at the same time.

The case is not at all parallel to the so called unearned increment of land. That the company owns. It does not own the pavements, and the laying of them does not add to its investment or increase the cost to it of producing gas. The cost of reproduction less accrued depreciation rule seems to be the one generally employed in rate cases. But it is merely a rule of convenience and must be applied with reason. On the one hand it should not be so applied as to deprive the corporation of a fair return at all times on the reasonable, proper and necessary investment made by it to serve the public, and on the other hand it should not be so applied as to give the corporation a return on improvements made at public expense which in no way increase the cost to it of performing that service.

APPRECIATION OF LAND—We agree with the Appellate Division that annual increase in the value of land is not income. Of course, under the rule of the Ames Case (supra), land might become so valuable as to require its use for other purposes and as to make a rate based on it unfair to the public. The present is not such a case.

M

Surface Dressings for Oiled Roads

With the coming of the spring and summer seasons, many macadam roads will be given their regular coating of bituminous binder and gravel or stone screenings. It has been found by experience that satisfactory results depend not only on the chemical and physical properties of the binder used but upon the physical characteristics of the screenings or gravel as well. Experience with asphaltic oil in the East has shown that the oil and rain water will frequently form an emulsion whenever the grit of the wearing coat becomes sufficiently pulverized. Instances of top dressings which successfully resist the soakings of rain and the kneading of traffic are sufficiently rare to be interesting.

Some roads and streets in the vicinity of Plattsburg, N. Y., have been noticed from their ability to resist this oily mud nuisance. Inquiry into how this result is accomplished has elicited the following information. The material used on these roads in place of stone screenings is known as "Harmony" iron-ore tailings, furnished by Witherbee, Sherman & Co., Mineville, N. Y. Used with asphaltic oils the results have been satisfactory where with ordinary stone screenings the results have been just the reverse.

Mechanical and chemical analyses of this material are given below:

			Per cent.
Through	4-on	8-mesh sieve	10.00
Through	8-on	10-mesh sieve	11.25
Through	10-on	20-mesh sieve	31.25
Through	20-on	40-mesh sieve	20.00
Through	40-on	60-mesh sieve	11.25
Through	60-on	80-mesh sieve	3.75
Through	80-on	100-mesh sieve	2.50
Through	100-on		10.00

Fe_2O_3, 9.94%; FeO, 6.97%; SiO_2, 63.48%; Al_2O_3, 7.50%; CaO, 4.45%; MgO, 1.57%; P_2O_5, 1.54%; MnO, 0.02%; S, nil; TiO_2, 1.81%; $CaCo_3$, 1.40%; K_2O plus Na_2O, 1.43%.

In and about New York City a hard, sharp gravel washed free from sand and dirt, and screened through a ¼-in. ring, has given marked satisfaction when used with "Tarvia B." This material is known as "Roslyn grits" and is mined by the Phœnix Sand & Gravel Co., at Cow Bay, Long Island. It costs only about half as much as stone screenings.

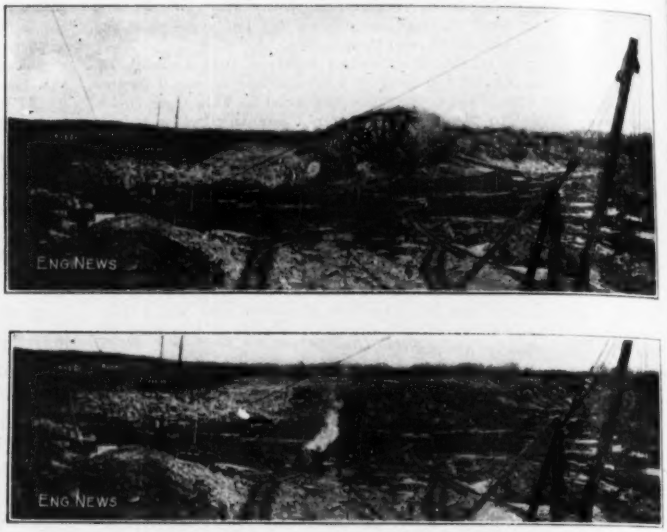
A Notable Blast at the Kensico Dam

By Wilson Fitch Smith*

A large blast was fired on Mar. 20, 1914, at the quarries for Kensico Dam, a part of the Catskill water-supply system, now under construction for the City of New York. The quarries are located on high ground about a mile east of the dam site. They include a ridge of Yonkers gneiss of fine grain and texture. Several openings have been made for the production of the various kinds of stone necessary, namely, the crushed stone for the concrete, large fragments for the cyclopean stones and the material for the dimension stone masonry, which will form the exposed downstream face of the dam. For the crushed stone, a large area is drilled and blasted, and the product loaded by a 5-cu.yd. steam shovel into 8-cu.yd. dump cars, and delivered to the crushing plant a short distance away.

The blast fired on Mar. 20, covered an area about 100 ft. wide and 900 ft. long. The holes, which averaged 40 ft. in depth, some of them being 50 ft. deep, and spaced from 10 to 20 ft. apart, were drilled with Temple Ingersoll electric carriage drills, using steel 52 ft. long. A total of 142 holes were used. Eleven tons of 60% dynamite were used in springing these holes. They were then loaded with 30 tons of 60% and 2½ tons of 40% dynamite, the heaviest charge in any one hole being 1400 lb.

It is estimated that about 120,000 cu.yd. of rock was broken up ready for the steam shovel, involving the use of 0.18 lb. of dynamite per cu.yd. for springing and 0.54 lb. per cu.yd. for blasting, or a total of 0.72 lb. per cu.yd. of loosened rock. The accompanying photographs show the blast at the instant of maximum disturbance and the subsequent appearance of the material. The height to which the rock was lifted can be estimated by observing the way it hid the small dwelling in the right of the picture. The quarries are the property of, and have been developed by H. S. Kerbaugh, Inc., the contractors building the Kensico Dam.



A 120,000-Cu.Yd. Blast at the Kensico Dam Quarries
(The upper view shows the blast in action and the lower view its effect.)

Cause of Springfield Water-Pipe Break Still Unknown

The break in a water pipe at Springfield, Mass., described in our issue of Mar. 5, 1914, p. 540, was not in a 36-in. main, as inadvertently stated by our headline writer. The article itself, prepared for this journal by Elbert E. Lochridge, chief engineer, Springfield Water Department, stated clearly that the 36-in. main did not break, although it was water escaping from a hydrant branch from the 36-in. main which caused the collapse of a brick buidlng. Whether the original break was in this hydrant branch or in a service connection leading to the wrecked house had not been learned on Mar. 26, when Mr. Lochridge wrote us on this subject as follows:

No cause has as yet been determined for the flooding of property on Water St. from the 36-in. main on Mar. 1. All of the earth which was in any way affected by water within the street line was removed by employees of the Water Department and neither hydrant nor side connection were found. The lead joint in the bell projecting from the special on the 36-in. pipe remained in place, the lower portion of the lead being flattened as would have resulted from the drop of the side connection and hydrant, surrounded, as it was, with frozen earth, the compression being due apparently entirely to such pressure.

The foreman who first responded states that at the time he reached the house the hydrant was in its proper place at the curb and that it was some time later before it dropped. The hole below the house is considerably deeper than the excavation in the street, but it has been filled by the débris of the brick house and its contents. Workmen have been removing this débris since this time, but as yet no traces of the hydrant or connection have been found.

It has been determined that the service in the house had been frozen for some little time, and as, on the night of the break, rain followed a considerable period of very cold weather, it is entirely possible that some portion of the service burst, thus releasing the water first into the basement of the house.

The amount of earth moved by the water was considerable, surrounding basements being filled to a considerable extent with sand and the sidewalks and streets in the vicinity being covered to a depth of several inches. The amount of water flowing was too great to have come from a 1-in. service connection, but as the service is within 5 ft. of the hydrant branch, it is probable that the flow was first manifest in the basement of the house and that it was the undermining of the frozen earth which caused the later settlement of the hydrant and branch.

It is still hoped that these connections will be found, as their condition will tell much of the cause of the break. A break in the hydrant branch would have caused much of the same effect, but would undoubtedly have resulted in the early collapse of the earth about the curb and the hydrant, which, according to those who were early on the ground, did not occur until later.

It is a matter of small importance to correct, but the fire in the Park Theater was two blocks distant and in the same business district and not two miles distant, as was stated in the article.

Designs for Small Sewage-Disposal Works ranging in size from individual sanitary privies to works for the disposal of sewage from small institutions, summer hotels, etc., are to be made for the United States Public Health Service by Leslie C. Frank, sanitary engineer, United States Public Health Service, under the supervision of Prof. Earle B. Phelps, chief of the Division of Chemistry, and under the general direction of Dr. John F. Anderson, Director of the Hygienic Laboratory, United States Public Health Service, Washington, D. C.

*Division Engineer, Board of Water Supply, City of New York, Valhalla, N. Y.

P. Alex. Peterson, Late Past-President of the Canadian Society of Civil Engineers*

On Nov. 21, 1913, there passed away, in Montreal, Que., P. Alex. Peterson, a civil engineer, who took a leading part in railway construction in Canada, during the latter part of the 19th century.

Mr. Peterson was born in Niagara Falls, Ont., on Nov. 8, 1839; and in July, 1859, after a thorough school education, he was articled to Thomas C. Keefer, who was at that time Chief Engineer of the Hamilton, Ont., water-works, and of the Hamilton & Port Dover Ry. (Mr. Keefer is now 93 years old and is an Honorary Member of the Canadian and American Societies of Civil Engineers and of the Institution of Civil Engineers of Great Britain. John Kennedy, now Consulting Engineer to the Montreal Harbor Commissioners, was also employed in Mr. Keefer's office at the same time.)

While Mr. Peterson was assistant to Mr. Keefer, he gained experience on the Hamilton & Port Dover Ry., the Hamilton water-works, and on a survey for a canal from Georgian Bay to Toronto. From 1863 to 1865, he was engaged on various other engineering works under Mr. Keefer, and in July, 1863, he obtained a license to act as an Ontario land surveyor.

In May, 1865, Mr. Peterson left Mr. Keefer's office and went into practice on his own account, and during 1865 and 1866, he had charge of the reconstruction of three large dams on the Grand River, to replace those which had been carried away in floods caused by ice jams.

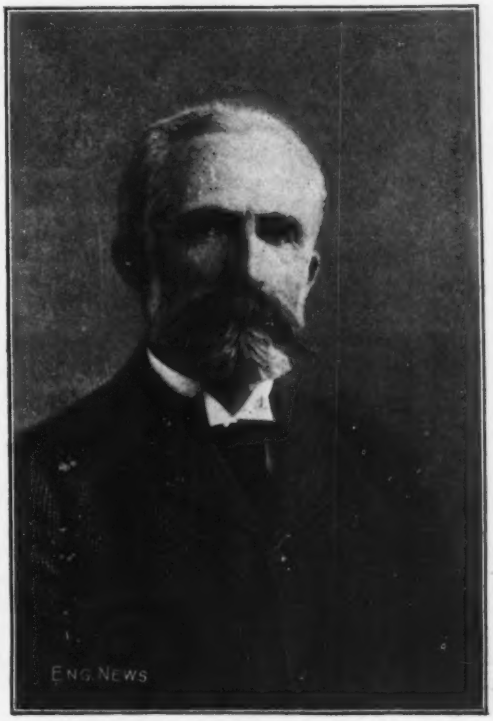
In the summer of 1867, he made surveys, plans and estimates for the Petrolia branch of the Great Western Ry.; and in the autumn of 1867, he was appointed Resident Engineer of the Northern division of the New York & Oswego Midland Ry. In March, 1868, he was appointed Resident Engineer of the Bathurst division of the Intercolonial Ry., in New Brunswick, the construction of which was then being commenced. He remained in that position until September, 1872, when he resigned to become Chief Engineer of the Toronto water-works, then about to be constructed at a cost of $2,000,000, which included the construction of a large filter basin, and the laying of 4500 ft. of 36-in. flexible-joint pipe across the harbor.

Previous to 1875, Mr. Peterson had been elected a member of the Institute of Civil Engineers, and in January, 1876, he was elected a member of the American Society of Civil Engineers, of which he was a Vice-President in 1896 and 1897.

Toward the end of 1875, Mr. Peterson left the Toronto water-works, having been appointed by the Quebec Government, Chief Engineer of the Montreal & Ottawa section of the Quebec, Montreal, Ottawa & Occidental Ry., which was at that time partly constructed. Mr. Peterson strongly urged the adoption of a direct line from a point near Berthier to Montreal via Bout de l'Isle, and the construction of a large bridge at the latter place. The government, however, in June, 1878, obtained a report from the late Walter Shanly, advocating the line via Terrebonne, St. Vincent de Paul and St. Martins Junction with two large bridges and with two long, heavy grades up to and down from Mile End. The latter plan was adopted and the line has proved "a thorn in the side" ever since, while the Canadian Northern Ry.'s Quebec line has adopted Mr. Peterson's route.

Mr. Peterson's "forte" was the location and construction of bridge substructures; and while Chief Engineer of the Quebec, Montreal, Ottawa & Occidental Ry., he had charge of the construction of the Chaudiere bridge between Hull and Ottawa, having one span of 254 ft., one of 160 ft., ten of 150 ft. and one of 135 ft., and large bridges over the Rouge, North Nation, Lievres and Gatineau Rivers.

In 1881, he was appointed, by the Canadian Pacific Ry., Chief Engineer of the Atlantic & Northwest Ry., under the charter by which the Canadian Pacific Ry.



built the line from Mile End Station, near Montreal, to connect with the International Ry., of Canada, at Lennoxville. At the same time a railway was built under another charter, from the International boundary near Megantic to Mattawamkeag, in Maine, of which Mr. Peterson was also Chief Engineer.

The St. Lawrence River bridge, at Caughnawaaga, is on this line, and the original piers were built so strong that with necessary lengthening they could be used to carry the heavy double-track steelwork which, by a strange coincidence, was completed only a month before Mr. Peterson's death. On the same line were several large steel bridges and trestles, including a bridge over the Richelieu River and high trestles at Ship Pond and Wilson Stream.

*Contributed by request by H. Irwin, Consulting Right-of-Way and Lease Agent, Canadian Pacific Ry., Montreal, Que.

Mr. Peterson was also Chief Engineer of the Sault Ste. Marie bridge and of the Mission River bridge, in British Columbia, and many other important works.

He continued to act as Chief Engineer of the Atlantic & North West Ry., and as Engineer of Eastern lines of the Canadian Pacific Ry. until he was appointed Chief Engineer of the whole Canadian Pacific Ry., in 1890, which position he held for 12 years, until February, 1902, when, owing to ill health, he was appointed Consulting Engineer.

In August, 1903, he was appointed Chief Engineer of the Guelph & Goderich Ry., then being constructed by the Canadian Pacific Ry., and he held that position until 1908, when he retired from active work, owing to failing health.

Mr. Peterson was a charter member of the Canadian Society of Civil Engineers, of which he was a Vice-President in 1889, 1892 and 1893, and President in 1894.

Of rather a nervous disposition, he was, at first, sometimes thought to be slightly abrupt in manner, but his unvarying courtesy soon removed that impression. He was universally known as a most conscientious engineer; was strict, yet fair in dealing with contractors; was very kindhearted, and always willing to do a good turn for any of his staff, though he required from them close attention to their work and whole-hearted discharge of their duty to their employers.

A City Engineer Appointed City Manager of Inglewood, Calif.

The first city on the Pacific Coast to adopt the city-manager plan, as far as we know, is Inglewood, Calif. The action of Inglewood is of particular interest to the readers of ENGINEERING NEWS because the city authorities followed the very rational plan of appointing as city manager their own city engineer, whom they believed had shown his qualifications for the position by the good work which he had done during the two years he had held the office of city engineer. This man was Paul E. Kressly, a man 32 years of age, who had been practicing civil engineering for the past twelve years. Up to three years ago, Mr. Kressly practiced in South Bethlehem, Penn. During that time he was engineer for the Boroughs of Nazareth, Fountain Hill and Freemansburg. During the years 1912-13, street improvements were carried out at Inglewood under the direction of Mr. Kressly as city engineer at a total cost of about $380,000.

As city manager of Inglewood, Mr. Kressly will have charge of all engineering work and all the work pertaining to the street, water, light, building, electrical, plumbing, fire, police and health departments, as well as the management of the park and playground commissions.

Mr. Kressly was appointed city manager on Mar. 2, in accordance with the terms of an ordinance creating the office and defining its duties approved on the same day. Under the terms of this ordinance, the city manager is appointed by the Board of Trustees and holds office during the pleasure of the board with such salary as the board may from time to time determine.

The duties of the city manager of Inglewood, as set forth in the ordinance, are as follows:

It shall be the duty of the City Manager and he shall have power:

(1) To see that the laws and ordinances of the city are enforced;

(2) To exercise control over all the departments of the city and direct the work of all appointive officers;

(3) To employ and dismiss all city employees;

(4) To superintend the construction of all public work within the said city;

(5) To approve or disapprove the requisition for the purchase of any article or articles for the said city, by any department or officer, before the purchase is made;

(6) To attend all meetings of the Board of Trustees and to recommend to the said Board for adoption such measures as he may deem necessary or expedient;

(7) To keep the Board of Trustees fully advised as to the financial condition and needs of the city; and—

(8) To perform such other duties as may be prescribed by ordinance or resolution of the Board of Trustees;

Provided, however, that any and all acts of the said City Manager under this ordinance, shall be subject to the approval and control of the Board of Trustees of the City of Inglewood, and they shall have full power to correct and set aside any action taken by him under this ordinance whenever they shall deem it proper to so do; and provided further that the Legal Department of said City and the City Attorney are hereby expressly excepted from the operation of this ordinance.

All officers and departments of the said city, except as in this ordinance provided, are hereby declared to be subject to the control of the said City Manager, and no officer or department of the said city shall incur any indebtedness upon behalf of said city until a requisition for the same shall have been first presented to the City Manager and shall have received his approval. Any violation of this section shall render the person so violating subject to immediate discharge from the employ of said city.

In accordance with the last paragraph of the quotation, the new city manager has issued the following order:

That from and after Mar. 6, 1914, no goods, etc., are to be furnished to any official or employee of the city of Inglewood, unless accompanied by an order similar to the one hereto attached, and signed by the City Manager.

The city of Inglewood will not be responsible for any goods furnished without the order hereinbefore referred to.

NEWS NOTES

A Temporary Bridge Was Washed Out by floods on the Mohawk River, at Amsterdam, N. Y., on Mar. 27.

A Gas Explosion Tore Two Large Holes in a street at Chester, Penn., on Mar. 24, according to press dispatches.

Electrification of the Great Northern Ry. in Montana, which has been variously reported as decided upon, it is now officially stated, is not being considered in any way.

Exhaustive Tests of the Electrolysis of Water Mains are to be made at San Diego, Calif., under the direction of H. A. Whitney, hydraulic engineer, and Herbert R. Fay, superintendent, Department of Water.

Lives Lost in the Missouri Athletic Club Fire on Mar. 9, and by the west wall blown down on Mar. 18, numbered 37. The club has been reorganized under the name of the Missouri Athletic Association, and plans for a new club house are under way.

A Brief and Pointed Code of Ethics—The recently organized Oklahoma Society of Engineers has the following code of ethics:

It shall be deemed unprofessional and inconsistent with honorable or dignified bearing for any member of the O. S. E.:

(1) To attempt to directly or indirectly damage, falsely or maliciously, the professional standing or reputation of a fellow engineer or engineering firm.

(2) To attempt to supplant a fellow engineer or engineering firm after his retainment or employment.

(3) To reduce his usual charges for professional work when in competition with fellow engineers or engineering firms or to underbid his competitors after being informed of their charges for the work.

(4) To accept any commissions, discounts, or indirect profit in connection with any work on which he or his engineering firm is engaged, except with the knowledge of the employer.

Panama Canal Excavation during February totaled 1,430,059 cu.yd., a daily average of 62,176 cu.yd. for each of the 23 working days. Rainfall was 0.53 in. The amount of concrete laid during the month was 3541 cu.yd. and 15,980 cu.yd. of fill were placed in dams.

Large Reductions in Railway Operating forces were announced last week. On the Pennsylvania lines it is stated that 25,000 men have been laid off and on the New York Central lines, an equal number. The heaviest reductions have been made on the construction department, where work has practically ceased.

Sentence Wreck Engineer and Conductor in France—The engineer and conductor of the Marseilles-Paris Express, which was wrecked at Melun, France, on Nov. 4 ("Eng. News," Nov. 13, 1913), with a loss of 39 lives, were sentenced on Mar. 27 to four months and one month imprisonment, respectively. The charge was criminal negligence.

Maintenance of a Main Line Highway from Washington, D. C., to Atlanta, Ga., under control of engineers detailed from the office of Public Roads, is a task which has been undertaken by the American Highway Association. The work of maintenance is to be done by labor provided by the State and county officials along the route of the highway.

A Heavy Ice Jam Wrecked a Bridge of the Fort Wayne & Northern Indiana Traction Co., at Brown St., Lafayette, Ind., on Mar. 13. The bridge was a temporary structure built by the company last summer to replace one carried out by the spring flood, and is reported to have cost $15,000. The ice jam, about 200x100 ft., broke loose above the bridge and swept down upon the middle section, wrecking the structure.

A Pile and Brush Dam at Seattle, Wash., Failed, on Mar. 13. It separated Lake Union from the western end of the Lake Washington Canal. The rush of water from Lake Union, which is at a higher elevation than the canal, scoured the piling of the Fremont Ave. bridge just east of the dam, causing the bridge to collapse. The dam was built by the U. S. Government about 11 years ago. The dam and canal are part of a project described in "Eng. News," Jan. 6, 1910.

To Protect the Water-Supply of Everett, Wash., a cooperative agreement has been made between the United States Secretary of Agriculture and the city of Everett, which gives the latter the use of the entire Boulder River drainage area within the Snoqualmie National Forest. As we understand it, a hydro-electric municipal power plant is made possible by the grant. The United States Forest Service will construct trails and the Federal Government will build telephone lines within the drainage area.

A Snow-Removal Conference will be held at Philadelphia, Apr. 16 and 17. The conference has been called by M. L. Cooke, director of public works, acting on the advice of commissioners of public works of a number of cities. It is hoped that representatives of street railways will also be present. Mayor Blankenburg proposes to give a dinner to the visitors on the evening of Apr. 16. The conferences proper will be held Friday, Apr. 17, morning and afternoon. Anyone interested is invited to attend.

New Union Station for Cleveland, Ohio—The citizens of Cleveland, Ohio, are soon to vote on a referendum for the approval of the sale of Lakewood Park land needed for a new union station, to cost $17,000,000. The plans accepted provide for a building 500 ft. in width with two entrances on the main front. The height will be about 80 ft. The proposed building will also be used for office purposes by the Lake Shore & Michigan Southern Ry. and the Pennsylvania R.R. The architects are D. H. Burnham & Co., Chicago, Ill.

Transporting a 250-Ton Rock from Long Island to the John D. Rockefeller estate at Tarrytown, N. Y., constitutes a severe test to roads and pavements. The village boards will not grant permission to use the streets for this purpose unless a bond is furnished. The New York Board of Water Supply requires that a steel facing shall be built for the Bedford Road across the old Croton aqueduct before the load is carried over it. The rock, which is about 20 ft. in diameter, is to be moved and placed in front of Mr. Rockefeller's mansion some time this month.

A Train Derailment caused by wreckers occurred March 22 on the Chicago, Milwaukee & St. Paul Ry., within the city limits of Chicago. The engine and one or two cars of a through train for the Pacific Coast were overturned, and the enginemen and baggageman were injured, but no passengers were injured seriously, partly due to the use of steel cars, although the baggage car was of timber construction. It was found that a rail had been unbolted and loosened, and the railway company has stated that similar attempts have been made to derail this same train.

The Providence Subway plans noted in "Engineering News," March 19, 1914, seem to have been accepted by the Board of Aldermen and Common Council. The resolution recommended by the special committee on subways, directing the City Solicitor to apply for state legislation enabling the city to design and build a system as outlined, has been reported adopted by both bodies. Two amendments have been accepted, one providing that the Transit Commission shall spend no money unless authorized by the City Council and the other stating that the members of the Transit Commission should serve without pay.

The Wreck of the Steamer "Monroe" was blown up on Mar. 26, by the U. S. revenue cutter "Onondaga." Masts, superstructure, and upper deck were blown off, leaving intact as much of the hull as possible below eight fathoms, so that the cargo may be recovered. Wreckers for the insurance underwriters had recovered 160 bales of cotton. Salvage operations were resumed as soon as the revenue cutter completed its work. The Old Dominion liner "Monroe" was sunk by collision with the "Nantucket" of the Merchant and Miners' Line, on Jan. 31, about 50 miles of the Virginia Capes, in a dense fog at 2 a.m., with a loss of 41 lives ("Eng. News," Feb. 5, 1914). None of the bodies has been recovered.

Difficulties in Closing the 30-in. Gate Valves of the Shoshone Dam were reported some weeks ago. We are informed by F. H. Newell, director U. S. Reclamation Service, that the cause of the trouble has not yet been ascertained, as backwater below the dam makes the gates inaccessible for the present. The difficulty seems to have arisen when an attempt was made to close the valves under a head of 227 ft. of water. It was found impossible to close all the valves by hand. The valves in question are not a part of the main controlling works but are in small outlets near the original river level, designed for occasional use for sluicing purposes. There are two 30-in. parallel seat gate valves in series on each of 42 in. outlet pipes.

Bridge and Road Reconstruction in Hamilton County, Ohio, following the extensive flood damage of March, 1913, is well under way, according to a statement from Clinton Cowen, County Surveyor. All important roads and bridges are now under contract, and probably the entire work in question will be completed by the end of 1914.

Bridges whose masonry was damaged to any extent have been increased in length liberally. An example of this is the Union Levee bridge, across the Little Miami just east of Cincinnati, where the former single span of 350 ft. is being replaced by two 250-ft. spans. Where the old masonry was undisturbed, the waterway has been increased by raising abutments and piers 4 to 6 ft. with concrete caps.

The Prize Design for the Australian Capital, made by Walter Burley Griffin, of Chicago, appears now to be in the favor of the Government authorities and stands a fair chance of being put into service. It will be remembered that there was considerable official opposition to the adoption in toto of Mr. Griffin's design and it was decided to prepare a governmental plan which would incorporate the best in all of the submitted designs. Later and more considered thought made it apparent that such a plan could only be a hodge-podge, and it was decided some months ago to invite Mr. Griffin to Australia to confer there with the authorities. As a result of this conference, it is now announced that Mr. Griffin's plans, with minor changes accepted by their author, will be used as the design for the new federation capital.

Another 1000-ft. Dry Dock—The first dry dock to accommodate a ship 1000 ft. in length was the Gladstone dock at Liverpool which was opened last fall. Since the opening of that dock, however, two other docks of somewhat larger capacity have been started, one at Quebec and one at Boston. A fourth dock was added to the list during the past month, when the Hughes dry dock at Bombay, India, was opened. This dock is 1000 ft. long, 100 ft. wide, and has a depth of 33¼ ft. below high water over the sills. It is a part of the new Alexandra dock which provides three miles of deep water dockage in addition to the old Princes and Victoria dock at Bombay harbor. The new dry dock was at first intended to be the entrance lock to the Alexandra dock, but it was afterward placed alongside of the entrance lock and is to be used only as a dry dock.

A Proposed Law Covering Surveys and Descriptions of Real Property in conveyances has been drafted by Mathias R. Kondolf, P. O. Box 713, Rochester, N. Y., and others. The proposed law is quite lengthy and is divided into five sections, which provide that all conveyances, wherein a new or original line or boundary is established, must contain an exact description of permanent monuments and all necessary measurements for relocating them. The kind of monuments to be used and the method of setting them are provided for in detail. The object of the proposed law, of course, is to simplify the retracing of old survey lines and make survey de-

scriptions matters of interpretation for surveyors rather than for lawyers, as is frequently the case under the loose methods at present employed in many of the States. A copy of the law may be obtained from Mr. Kondolf by those interested.

Gas From the Imhoff Tank of the Peachtree Creek Sewage Works, Atlanta, Ga., showed the following analysis, expressed in percentages:

	Carbon dioxide	Oxygen	Hydrogen sulphide	Methane	Hydrogen	Nitrogen
Sample 1....	4.7	0.2	0.0	85.3	9.7	0.0
Sample 2....	5.2	0.5	0.0	82.8	8.2	3.3
Sample 3....	4.4	0.6	0.0	84.2	7.9	2.9
Sample 4....	4.2	0.4	0.0	....	...	...
Average	4.6	0.4	0.0	84.1	8.6	3.1

The analyses were made on Mar. 30, 1914, by C. C. Hommon, bacteriologist and chemist. The plant was put in use in October, 1913, so the samples analyzed may be reasonably supposed to represent the normal operation of the plant.—From W. A. Hansell, Jr., assistant engineer of construction, Atlanta, Ga.

Extensive Public Improvements at Philadelphia have been halted and some of them may have to be postponed for a considerable time by a decision of the State Supreme Court on March 30 declaring invalid proposed loans totaling $21,500,000. The ground for the decision appears to have been that the loans would have carried the city beyond the debt limit because some $6,500,000 of school bonds had not been included in calculating the limit. The decision enjoined an election called for March 31 to vote on a $12,900,000 loan and also declared invalid a loan of $8,600,000, voted in November, 1914. Among the purposes for which the two bond issues were to have been used were subway and other rapid transit improvements, harbor improvements, water pipe and purification extensions, sewers, pavements, and bridges. As soon as the text of the decision becomes available for guidance it is expected that a new loan ordinance will be passed and submitted to popular vote. Meanwhile some of the proposed improvements can be provided if the city council sees fit to authorize small beginnings of the work.

A Bill Requiring Civil Engineers and Surveyors to be examined and licensed was defeated in the Oklahoma legislature recently. The bill was prepared by a committee of the Oklahoma Engineering Society and was framed on the general lines recommended by a committee of the American Society of Civil Engineers two years ago. The bill defined the practice of civil engineering "as the practice of any branch of the profession of engineering other than military," including electrical, mechanical, mining and all other classes of engineering. Anyone practicing any branch of the engineering profession was required to take an examination and obtain a certificate from a state board of examiners, the fee charged being $25. Applicants for a certificate as a surveyor only were required to pay a fee of only $10. The bill also laid a heavy tax upon engineers from other states desiring to practice in Oklahoma, they being required to pay a fee of $50 on application and $200 on issue of the certificate. The bill was introduced in the legislature, but failed of passage. Another peculiar feature of the Oklahoma act was the provision that any city in the state could call upon the State Board of Examining Engineers for advice as consulting engineers upon plans and specifications for any public improvement.

A $500,000 U. S. Mine-Experiment Station is planned for erection in Pittsburgh, Penn., during the coming summer. The plans include three main buildings. The central and largest will be three stories high and known as the Mining building. It will be flanked by two others, the Mechanical and the Chemical buildings. In the rear and inclosing a court will be the Service building; beyond and spanning a ravine known as Panther Hollow and connecting the Bureau of Mines buildings with the Carnegie School of Technology situated opposite, will be two small buildings, one for furnishing power and the other for storing fuel. The roofs of these two buildings will carry the roadway from Ford St. to Schenley Park.

A series of mine shafts will be provided. One will be used as an elevator, another for tests of mining appliances, e.g., hoisting ropes, while a third will give entrance to tunnels extending under the buildings, in which mining experiments will be conducted. The portion of Panther Hollow above the power building will be arranged as a miners' field, the slopes of the ravine forming an amphitheater which will accommodate 20,000 spectators of demonstrations in mine rescue and first aid.

The present headquarters of the Bureau of Mines, also at Pittsburgh, comprises buildings loaned by the War Department, which now requires their use.

The Union Station at Chicago is to be rebuilt on a very comprehensive plan, the ordinances necessary for the work having been passed by the City Council on March 23 by a vote of 63 to 3. It will be on the general lines submitted about a year ago by the Pennsylvania Lines, but very much improved in regard to the street approaches, bridges and other municipal aspects of the terminal.

The station is used by the Pittsburgh, Fort Wayne & Chicago R.R., the Pittsburgh, Cincinnati, Chicago & St. Louis Ry., the Chicago, Milwaukee & St. Paul Ry., the Chicago, Burlington & Quincy R.R., and the Chicago & Alton R.R. Trains of the second and third of these lines enter and leave at the north end, and those of the other lines enter and leave at the south end. So that although the tracks run through the station, it is operated as a double-end stub terminal. The new plans provide for two separate groups of stub tracks with a concourse between their ends, and two or three through tracks for any necessary switching movements. In addition to the passenger station there will be two new freight terminals, one for the Pennsylvania Lines and the other for the Burlington Line. About $15,000,000 has been spent for land, and the passenger terminal with all its appurtenances is expected to cost $40,000,000 while the freight terminals will bring the total up to nearly $65,000,000. The Chicago railway terminal problem was discussed in our issue of July 31, 1913.

The White Star Steamer "Brittanic" a sister-ship to the "Olympic" and the ill fated "Titanic," but somewhat larger in size and with many structural changes introduced as a result of the loss of the last named vessel, was launched from the shipyards of Harland & Wolff at Belfast, Ireland, on Feb. 26. The "Brittanic" gross tonnage is about 50,000 and her propelling machinery, which consists of triple expansion reciprocating engines exhausting into low-pressure turbines, is of about 50,000 hp. Her main dimensions in tabular form are as follows:

Length over all	about 900 ft.
Breadth, extreme	about 94 ft.
Depth, molded	64 ft. 3 in.
Total height from keel to navigating bridge	104 ft. 6 in.
Gross tonnage	about 50,000 tons
Load draft	34 ft. 7 in.
Displacement at load draft	over 53,000 tons
I.hp. of reciprocating engines	32,000
S.hp. of turbine	18 000
Passenger accommodation	for over 2500
Crew accommodation	for 950

The hull has 16 transverse bulkheads of which 5 extend to the bridge deck and the remainder to the upper deck. The hull also has an inner skin extending from the top of the double bottom to 3 ft. 6 in. above the middle deck, or well above the water line. The vessel is designed for a sustained sea speed of 21 knots. The tops of the four funnels are 180 ft above the keel and the tops of the masts are over 200 ft. above the load water line.

Valuation of Public Utilities in Ohio is required by the State Public Utilities Commission. Every corporation under the Commissioner's supervision is to be required to make an inventory and appraisal of its property and return it to the Commision before Aug. 1. The Commission's order requires of each company not only a list of its physical property and its fair value, new and depreciated, but it requires detailed statement of every other value claimed for the following reasons:

First—Any value claimed for "good will," for "going value," for "financing" or for any other reason, together with the basis for the claim.

Second—Any value claimed for the possession of a contract to perform the public service (franchise value), together with the basis for the claim.

Third—Overhead expenses during the time of theoretical reconstruction, stating what expenses were included in the estimate, with the percentage for each or a total percentage for all.

The inventory of physical property must include all land, together with statements of original cost, date of acquisition and present value of each parcel. Other items, such as buildings, plants, equipment, tools and transmission lines must be set down in classified groups showing new reproduction value accompanied by statements of depreciation by mechanical deterioration, obsolescence, lack of utility, or any other cause, in each instance showing the amount of depreciation in both percentage and money value.

The Miami Conservancy District Hearing on a petition for the formation of a flood-prevention district embracing parts of ten Ohio counties, including Dayton, Ohio, was opened on Mar. 20, at Dayton, according to schedule, but was adjourned to Mar. 31, to hear legal arguments on the constitutionality of the Conservancy Act (see "Engineering News," Feb. 5, 1914, for outline of the act). The question of constitutionality had been raised on a property owner's application to the

Court of Appeals for a writ of prohibition to prevent action on the petition by the Conservancy Court, which is composed of one judge from each of the Courts of Common Pleas of the ten counties, parts of which make up the proposed district. The Court of Appeals held that the constitutional questions must first be passed upon by the lower courts, beginning with the Conservancy Court itself. Presumably this will cause a series of delays in the hearing to determine whether or not the district shall be formed.

It is interesting to note that although the Conservancy Act provides for conservancy boards, which shall prepare and adopt plans, with the aid of engineers appointed for the purpose, preliminary plans for what has since become the proposed Miami Conservancy District have already been prepared by the Morgan Engineering Co., of Memphis, Tenn. (see "Engineering News," Oct. 16, 1913, p. 775). These plans were approved in January by an advisory board of engineers, consisting of Prof. D. W. Mead, of Madison, Wis.; J. W. Alvord, of Chicago, and Prof. I. M. Woodward, of Iowa City, Ia. For some days before the date set for the hearing of Mar. 20 there were assembled at Dayton to serve further in an advisory capacity, not only the three engineers just named, but also Brig.-Gen. O. H. Ernest, of Washington, D. C., and Brig.-Gen. H. M. Chittenden, of Seattle, Wash., each of the Corps of Engineers, U. S. A., retired; Col. J. A. Ockerson, of St. Louis, Mo.; W. A. O'Brien, of Cape Girardeau, Mo.; C. H. Miller, of Little Rock, Ark.; T. W. Jaycox, of Denver, Colo.; Morris Knowles, of Pittsburgh, Penn.; and James H. Fuertes, of New York City.

PERSONALS

Mr. John T. Mooney, General Superintendent of the Western New York Water Co., Buffalo, N. Y., has resigned.

Mr. T. H. Nichols, Assistant Roadmaster of the Great Northern Ry., at Spokane, Wash., has been promoted to be Roadmaster at Marcus, Wash.

Mr. Walter C. Allen, Jun. Am. Soc. M. E., recently General Manager of the Yale & Towne Manufacturing Co., Stamford, Conn., has been elected a Vice-President.

Mr. E. K. Mentzer has been appointed Supervisor of Bridges and Buildings on the Boston division of the Boston & Albany R.R., with headquarters at Worcester, Mass.

Mr. L. W. Bowen, Division Superintendent of the Great Northern Ry., at Spokane, Wash., has been promoted to be Assistant General Superintendent of the Eastern district at St. Paul, Minn.

Mr. George M. S. Schulz, a New York City lawyer, has been appointed a member of the New York State Public Service Commission, First District, succeeding Mr. John E. Eustis, whose term has expired.

Mr. J. J. Murphy, recently Trainmaster of the Chicago, Milwaukee & St. Paul Ry., at Malden, Wash., has been appointed Superintendent of the Rocky Mountain division, with headquarters at Three Forks, Mont.

Mr. H. F. Huy, formerly Principal Assistant to the Chief Engineer of the American Pipe & Construction Co., Philadelphia, Penn., has been appointed General Manager of the Western New York Water Co., Buffalo, N. Y.

Mr. O. E. Carr, for the past two years Engineer in charge of the underground survey, division of sewerage, of the Engineering Department of the city of Cincinnati, Ohio, has been made City Manager of Cadillac, Mich.

Mr. D. B. Carson, Assistant General Manager of the Nashville, Chattanooga & St. Louis Ry., Nashville, Tenn., has been appointed Acting General Manager, succeeding Mr. John Howe Peyton, M. Am. Soc. C. E., who has become President.

Mr. J. H. O'Neill, Assistant General Superintendent of the Great Northern Ry. at Spokane, Wash., has been promoted to be General Superintendent at Seattle, Wash., succeeding Mr. J. Russell, resigned as noted in our issue of last week.

Mr. Fred B. Smith has been appointed Assistant to the President of the H. W. Johns-Manville Co., New York City. For several years Mr. Smith has been Secretary of the International Committee of the Young Men's Christian Association.

Mr. G. A. Gessner, Jr., M. Am. Soc. C. E., Consulting Engineer, of the W. J. Sherman Co., Toledo, Ohio, has been appointed Superintendent of the Water-Works Department of Toledo. Mr. Gessner was educated at Lehigh University in civil engineering and for the past 15 years has been in business in Toledo.

Mr. James D. Mortimer, Assoc. Am. Inst. E. E., recently Vice-President of the North American Corporation, New York City, has been elected President. Mr. Mortimer is only 35 years old. He was born at Elmhurst, Ill., and studied electrical engineering at the University of California and the Throop Polytechnic Institute.

Mr. Dorr Skeels, recently Logging Engineer, United States Forest Service, with headquarters at Missoula, Mont., has been appointed Dean of the new Montana State School of Forestry of the University of Montana. Mr. Skeels has been in the U. S. Forest Service since 1906, and for several years has been a member of the staff of instruction of the university.

Lieut.-Col. William L. Sibert, M. Am. Soc. C. E, Corps of Engineers, U. S. A., member of the Isthmian Canal Commission and Division Engineer of the Atlantic division of the Panama Canal, including the Gatun dam and locks, has completed his work at Panama and has been ordered to Washington, D. C., to await further assignment by the Chief of Engineers.

Mr. George A. Taber, M. Am. Soc. C. E., Consulting Professor of water supply and sewage disposal at the Brooklyn Polytechnic Institute, has become a member of the engineering staff of Mr. Nicholas S. Hill, Jr., Consulting Engineer, 100 William St., New York City. Mr. Taber until recently was Assistant Engineer of the New York City Department of Water Supply, Gas and Electricity, in charge of the construction of extensions and additions to the distribution systems in the Boroughs of Manhattan, the Bronx and Richmond.

Mr. Cornelius C. Vermeule, Consulting Enginer, New York City, announces that he has associated with him Mr. Hubert K. Bishop, former First Deputy Commissioner of Highways of the State of New York, and more recently Superintendent of Public Works of the Territory of Hawaii. In addition to the practice in water supply, sanitary and hydraulic engineering conducted by Mr. Vermeule, the firm will also give special attention to highways, pavements and seacoast protection. The offices are at 203 Broadway, New York City.

Mr. Elisha Lee, Assistant to the General Manager of the Pennsylvania R.R., has been appointed General Superintendent of the Philadelphia, Baltimore & Washington R.R., with headquarters at Wilmington, Del., succeeding Mr. E. F. Brooks, retired. Mr. Lee is a graduate of the Massachusetts Institute of Technology, class of 1892, and has been with the Pennsylvania R.R. since November, 1892. Until 1909 he was in the engineering department and for two years was Principal Assistant Engineer of the Philadelphia, Baltimore & Washington R.R.

The Pennsylvania R.R. Lines West of Pittsburgh, announces the following promotions: Mr. W. E. Guignon, formerly Assistant Division Engineer, Chicago Terminal division, has been promoted to be Division Engineer of the Zanesville division; Mr. Harry J. Shaw, formerly Assistant Division of the Erie & Ashtabula division, has been transferred to the Chicago Terminal division; Mr. James L. Taylor, formerly Assistant Division Engineer of the Louisville division, has been transferred to the Erie & Ashtabula division; Mr. J. A. Rothrock, formerly Assistant Engineer of the Zanesville division, has been promoted to be Assistant Division Engineer of the Louisville division; Mr. F. V. Berkey, formerly First Assistant on the engineer corps of the Erie & Ashtabula division, has been promoted to be Assistant Engineer of the Zanesville division.

Col. Henry G. Prout, M. Am. Soc. C. E., recently First Vice-President and General Manager of the Union Switch & Signal Co., New York City, has been elected President of the company. For many years he was Editor of the "Railroad Gazette." As a young man he served with distinction in the Civil War. After the close of the work he graduated in civil engineering at the University of Michigan. Having served a short period with the Engineer Department of the United States Government he went to Egypt, where he became an officer in the engineer corps of the Khedive's army. He succeeded the famous General "Chinese" Gordon as Governor General of the Provinces of the Equator, when Gen. Gordon was made Governor General of Soudan. Col. Prout's career has been a remarkable combination of the distinguished soldier, engineer, statesman, editor and successful business man.

OBITUARY

T. Henry Dumary, President of the Helderberg Cement Co., died Mar. 16, at his home in Albany, N. Y.

Victor A. Sartori, senior partner of the firm of Sartori & Remington, Civil Engineers, Camden, N. J., died Mar. 27.

James Sheldon Cummins, Vice-President, Senior Counsel and one of the founders of H. M. Byllesby & Co., Chicago, Ill., died at his home in that city Mar. 23. He was born Mar. 22, 1857.

Robert M. Friedmann, a German bridge and structural engineer, committed suicide Mar. 27, by jumping from the 24th floor the Municipal Building, New York City. He was a graduate of the University of Berlin and had been in this country but a few months.

Walter Laidlaw, M. Am. Soc. M. E., Secretary of the International Steam Pump Co., died Mar. 25 from heart disease in an elevated railway station in New York City. Mr Laidlaw was born in Scotland in 1849. He received a technical education in his native country and soon after completing his school work he came to the United States. In 1886 he became associated with his brother, Robert Laidlaw, of Cincinnati, Ohio, in the Laidlaw-Dunn-Gordon Pump Co, manufacturers of steam pumps, which became a subsidiary of the International Steam Pump Co. Mr. Laidlaw had been a member of the American Society of Mechanical Engineers since 1889 and was a member of the Board of Managers from 1905 to 1908.

James Lewis Frazier, M. Am. Soc. C. E., of Louisville, Ky., an engineer of extended experience in the engineering and operating departments of railway service, died in Rome, Italy, Feb. 28. Mr. Frazier was born at Staunton, Va., June 17, 1849, and was educated at Washington and Lee University, and at the University of Virginia, graduating from the latter school in civil engineering. His engineering experience commenced in 1870, and in 1873 he was Assistant Engineer of Construction on the Chesapeake & Ohio R.R. and its extensions. He was engaged on the Cincinnati Southern Ry., under Mr. Bouscaren, during its entire construction, having charge of the bridge work. From 1874 to 1877 he was Assistant Engineer and Resident Engineer, and from 1878 to 1880 was again Resident Engineer, while for a few months in 1878 he was engineer on the location of the Western R.R. of North Carolina. In 1880 and 1881 he was Resident Engineer on the construction of the Elizabethtown, Lexington & Big Sandy R.R., and Assistant Engineer of Maintenance of Way on the Alabama Great Southern R.R. In May, 1881, he went to the Mexican National Ry. as Engineer of the bridge department, and in 1882-83 he held a similar position on the Louisville, Evansville & St. Louis Ry. (now a part of the Southern Ry.). In the early part of 1883 he was engineer in charge of erection for the Louisville Bridge & Iron Co. The remainder of his career was largely in the operating department. In March, 1883, he became Chief Engineer and superintendent of the road department of the Chesapeake & Ohio & Southwestern Ry., which is now part of the Chesapeake & Ohio Ry., and was with this latter road for some years as superintendent. In 1891 he went to the Southern Pacific Ry. and was Division Superintendent on different divisions until 1904, when for a short time he was General Superintendent of the Toledo, St. Louis & Western R.R. In 1904 he returned to California as General Manager of the California Northwestern R.R. and the North Shore R.R. His health became permanently impaired following a serious illness, and he retired from active work in 1905; since then his time had been spent partly in this country, but principally in Europe. He became a member of the American Society of Civil Engineers in 1880 and was a Director of the society from 1902 to 1904. He leaves a widow, formerly Miss Caroline Robinson, of Louisville, Ky., to whom he was married in 1887.

ENGINEERING SOCIETIES

COMING MEETINGS

EFFICIENCY SOCIETY.
Apr. 4-11. First annual conference in New York City. Offices at 41 Park Row, New York City.

MONTANA SOCIETY OF ENGINEERS.
Apr. 9-11. Twenty-seventh annual meeting at Great Falls, Mont. Secy. at Butte, Mont.

AMERICAN ELECTROCHEMICAL SOCIETY.
Apr. 16-18. Spring meeting in New York City. Secy., Prof. J. W. Richards, Lehigh University, Bethlehem, Penn.

NATIONAL DRAINAGE CONGRESS.
Apr. 22-25. Annual meeting at Savannah, Ga. Secy., J. R. Gray, Chamber of Commerce, Savannah, Ga.

IOWA STREET AND INTERURBAN RAILWAY ASSOCIATION.
Apr. 22-25. Annual meeting at Waterloo, Iowa. Secy., H. E. Weeks, Tri-City Ry. & Light Cos., Davenport, Iowa.

NATIONAL FIRE PROTECTION ASSOCIATION.
May 5-7. Annual meeting in Chicago, Ill. Secy., Franklin H. Wentworth, 87 Milk St., Boston, Mass.

AIR BRAKE ASSOCIATION.
May 5-8. Convention at Detroit, Mich. Secy., F. M. Nelis, 53 State St., Boston, Mass.

AMERICAN WATER-WORKS ASSOCIATION.
May 11-15. 34th Convention at Philadelphia, Penn. Secy., J. M. Diven, 47 State St., Troy, N. Y.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.
May 18-21. 4th convention in Chicago, Ill. Secy., C. G. Hall, C. & E. I. R.R., 922 McCormick Bldg., Chicago, Ill.

MASTER BOILER MAKERS' ASSOCIATION.
May 25-28. Convention at Philadelphia, Penn. Secy., H. D. Vought, 95 Liberty St., New York City.

Institute of Radio Engineers—The general office of the Institute is now at 71 Broadway, and all communications should be addressed to the Secretary, Emil J. Simon, at that address.

Engineers' Society of San Antonio—This Society, recently organized, is composed of men actively engaged in civil, mining, mechanical and electrical engineering in Bexar County. The President is R. H. Gresham; Vice-Presidents, W. B. Tuttle and W. E. Simpson; Secretary, Ernest Altgelt, 111½ N. Flores St., San Antonio, Tex. Meetings will be held at the Chamber of Commerce until permanent quarters are established.

Arkansas Engineering Society—The third annual meeting was held at the Jefferson Hotel, Pine Bluff, Ark., on Mar. 16-17. Two of the sessions were devoted to the reading and discussion of papers, among which were the following: "Sewage Disposal for Small Cities," Theodore Hartman, of Little Rock; "Water Works Design and Practice for Small Cities," W. D. Dickinson, of Little Rock; "Vertical Fiber-Brick Pavements," L. K. Parmalee, of Helena; "Wood-Block Pavements," D. A. McCrae, of Little Rock; "Bond Issues for Public Improvements," F. R. Allen, of Pine Bluff.

Several interesting inspection trips were taken and the following officers were elected: President, P. B. Hill; Vice-President, H. R. Carter; Secretary, W. J. Parkes.

American Foundrymen's Association—Richard Moldenke has resigned the Secretary-Treasuryship of the Association. A. O. Backert, of Cleveland, Ohio, is the new Secretary.

New York Railway Club—At the tenth annual "Electrical night," March 20, the feature was an address on Swiss Electrification by Emil Huber-Stockar, Consulting Engineer of the Swiss Federal Rys. He described the first work (1894), the three-phase line of 1899, the 800-volt direct-current road, the Simplon tunnel three-phase electrification and finally the new 15,000-volt single-phase system of the Lötschberg Ry. He reported 198 miles of railways under electric traction and 130 miles of this in the single-phase. The principal benefits sought were higher speed on grades, increased train tonnage, elimination of extra and helper locomotives, elimination of smoke in tunnels. He reported that the Electrification Commission of the Federal Rys. had recommended single-phase operation to secure the greatest possible flexibility of speed on the Swiss system as a whole.

In the discussion, George Gibbs, Consulting Engineer of the Pennsylvania R.R., described the plans for electric traction on the Norfolk & Western R.R. (mountain division) and the Pennsylvania R.R. at Philadelphia (suburban lines); in both cases increased capacity was sought. Mr. Gibbs also deprecated the tendency of manufacturers to attempt consulting engineering, claiming that they could not escape the taint of bias and could not secure the close contact with operating requirements so essential.

The final remarks of Mr. Gibbs were controverted by A. H. Armstrong, of the General Electric Co., in a general defense of work done.

W. S. Murray, Consulting Engineer of the New York, New Haven & Hartford R.R., described the 22,000-volt balanced distribution system now employed on that road's single-phase lines. This uses the track as a neutral conductor, the trolley being 11,000 volts above and the feeders 11,000 volts below track potential. This has eliminated the inductive disturbances in telephone and telegraph lines.

N. W. Storer, of the Westinghouse Electric & Manufacturing Co., described the split-phase (single-phase to three-phase) locomotives being built for the Norfolk & Western. These take single-phase current from an overhead conductor, passes it through an induction-motor phase converter to get two-phase current and finally changes to three-phase by a Scott connection on static transformers. The experimental mercury-rectifier a.c.-d.c. car being developed by the Pennsylvania and New Haven roads and the Westinghouse company was briefly described.

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